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Introduction

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Scientific and technical reports of the National Aeronautics and Space Administration and its contractors; scientific and technical reports of government agencies, universities, and research organizations throughout the world.

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The Preliminary Edition of the *NASA Thesaurus* (December 1967) (NASA SP-7030) is used as the authority for the indexing vocabulary that appears in the subject index to this issue. The terminology has been modified from the *Guide to the Subject Indexes for STAR* (NASA SP-7016), the authority used for the vocabulary to indexes published prior to 1968. The *NASA Thesaurus* should be consulted in examining the current indexing vocabulary, including associated cross reference structure. Only the subject terms that have been selected to describe the documents abstracted in this issue appear in the subject index. Copies of the *NASA Thesaurus* may be obtained from the Clearinghouse for Federal Scientific and Technical Information or the U. S. Government Printing Office at $8.50 for the three-volume set.

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Includes fixed-wing airplanes, helicopters, gliders, balloons, ornithopters, etc; and specific types of complete aircraft (e.g., ground effect machines, STOL, and VTOL); flight tests; operating problems (e.g., sonic boom); safety and safety devices; economics; and stability and control. For basic research see: 01 Aerodynamics. For related information see also: 31 Space Vehicles; and 32 Structural Mechanics. **3395**

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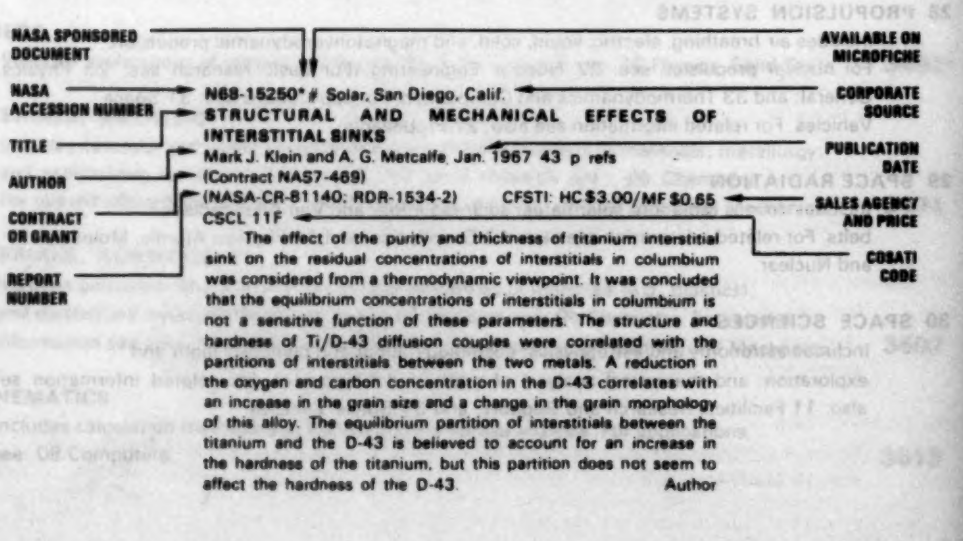
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Mark J. Klein and A. G. Metcalfe. Jan. 1967 43 p refs
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The effect of the purity and thickness of titanium interstitial sink on the residual concentrations of interstitials in columbium was considered from a thermodynamic viewpoint. It was concluded that the equilibrium concentrations of interstitials in columbium is not a sensitive function of these parameters. The structure and hardness of Ti/D-43 diffusion couples were correlated with the partitions of interstitials between the two metals. A reduction in the oxygen and carbon concentration in the D-43 correlates with an increase in the grain size and a change in the grain morphology of this alloy. The equilibrium partition of interstitials between the titanium and the D-43 is believed to account for an increase in the hardness of the titanium, but this partition does not seem to affect the hardness of the D-43. Author

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Scientific and Technical Aerospace Reports

A Semimonthly Publication of the National Aeronautics and Space Administration

01 AERODYNAMICS

Includes aerodynamics of bodies, combinations, internal flow in ducts and turbo machinery; wings, rotors, and control surfaces. For applications see: 02 Aircraft and 31 Space Vehicles. For related information see also: 12 Fluid Mechanics; and 33 Thermodynamics and Combustion.

N68-32300# College of Aeronautics, Cranfield (England).
AN EXPERIMENTAL INVESTIGATION INTO THE AERODYNAMIC CHARACTERISTICS OF A WING, WITH AND WITHOUT ENDPLATES, IN GROUND EFFECT
P.E. Kumar Mar. 1968 54 p refs
(Contract PD/28/016)
(COA-AERO-201) CFSTI: HC $3.00/MF $0.65

These wind tunnel tests were conducted on a wing of aspect ratio 2 in order to obtain a feel for the aerodynamic characteristics in ground effect, particularly in the lateral modes where there is a singular lack of knowledge. The effect of endplate and wingtip-body thickness on the forces and moments acting on the wing was investigated. In view of the nonlinear variations of the aerodynamic loads it was not possible to obtain aerodynamic stability derivatives as used in standard aircraft stability practice, but it is thought that step by step calculations, at various heights above ground, will yield a better understanding of the overall dynamic stability. In all tests the ground was represented by an image wing system. Author

N68-32333 California Inst. of Tech., Pasadena.
EXPERIMENTAL INVESTIGATION OF WAKES BEHIND TWO-DIMENSIONAL SLENDER BODIES AT MACH NUMBER SIX
Richard George Batt (Ph.D. Thesis) 1967 294 p
Available from Univ. Microfilms: HC $13.30/MF $3.80 Order No. 67-14360

An experimental investigation has been conducted to determine mean flow properties for both near and far wakes behind several two-dimensional slender bodies at $M_\infty = 6$. Three adiabatic wall models consisting of a flat plate model and two 20° included angle wedge models (H = .15", H = .3") were tested. The effect of wall temperature on wake properties was examined by cooling the larger of these two wedge models with the internal flow of liquid nitrogen ($T_w/T_o = .19$). Free stream Reynolds numbers were varied from $Re_\infty/in. = .5 \times 10^6$ to 2×10^6 for each of these four configurations. In the far wake, measurements of total temperature, as determined with hot wire probes, and Pitot and static pressures were used to derive all other mean flow properties. The effect of transition on these far wake data was determined. Near wake flows were laminar for all adiabatic wall tests and at least for the two lowest test Reynolds numbers of the cold wall wedge. Dissert. Abstr.

N68-32479 National Lending Library for Science and Technology, Boston Spa (England).
A NEW METHOD IN THE CALCULATION OF THE SMOOTH SUBSONIC FLOW ON THIN AEROFOILS WITH SMALL ANGLES OF INCIDENCE [NEUERE METHODE ZUR BERECHNUNG DER EBENEN UNTERSCHALLSTROEMUNG AN DUENNEN PROFILEN BEI KLEINEN ANSTELLWINKELN]
W. Gretler 20 Nov. 1967 56 p refs Transl. into ENGLISH from Acta Mech. (West Germany), v. 1, 1965 p 109-134 In GERMAN and ENGLISH
(EE-TRANS-1684) Available from Natl. Lending Library, Boston Spa, Engl.

A simple method is described which permits the calculation of pressure distribution on the surface of a thin, cambered airfoil at moderate incidence in compressible subsonic flow up to the second order. A complete derivation of the theory is given including a study of the flow near a rounded leading edge. Starting point is Green's formula, similar to that in the method of integral equation for calculating transonic flow proposed by Oswatitsch and Zierep. By means of integral transforms and application of Tricomi's convolution theorem the problem is reduced to the calculation of simple integrals. The derived formulas are particularly suitable for practical application, since knowledge of the profile ordinates only is required. The velocity on the airfoil surface, as given on a straightforward second approximation, is rendered uniformly valid near the leading edge by adding a few simple corrections. Author

N68-32516# RAND Corp., Santa Monica, Calif.
MAGNETIC HYPERSONIC FLOW NEAR THE STAGNATION POINT AT LOW REYNOLDS NUMBER
S. Y. Chen May 1968 37 p refs
(Contract F44620-67-C-0045)
(RM-5340-PR; AD-671921)

An investigation was made of the effects of wall temperature and of a magnetic field on the flow field at the stagnation point of blunt-nosed bodies in low-Reynolds-number hypersonic flow, with the intent of determining the possibility of using small magnetic fields to reduce heat transfer and skin friction in that region. Results indicate that a small magnetic field of the order of 1000 Gauss or less reduces both heat transfer and skin friction in high-altitude flight, but increases shock standoff distance. The strength of magnetic field required is attainable by a permanent magnet. Increasing the wall temperature tends to produce higher values of both the heat-transfer and skin-friction parameters, although the magnitude of the effect is less on the heat-transfer parameter. All of these effects diminish rapidly as the flow approaches the free-molecular-flow limit. Author (TAB)

N68-32612# Boeing Co., Renton, Wash. Commercial Airplane Div.

WIND TUNNEL INVESTIGATION OF ROLL RATE STABILITY DERIVATIVES—EXPLORATORY TESTS IN BTWT WITH A NEWLY DEVELOPED ROTATING STING SYSTEM

P. Smutny and M. C. Wilson 1968 41 p refs

(D6-20662-TN; AD-671676)

Results of the first wind tunnel test to measure the rotary derivatives of a research model, using the developed rotary rig, are presented. Tests were conducted covering the Mach range from .16 to .85, angles of attack zero, 4 and 10 deg, and Reynolds number per foot from 900,000 to 3,500,000. The measured derivatives are compared with estimated values based on handbook method, linearized lifting surface theory and test data of a similar model. Author (TAB)

N68-32712 National Lending Library for Science and Technology, Boston Spa (England).

THE INFLUENCE OF NOZZLE ANGLE ON THE EFFICIENCY OF IMPULSE STAGES

V. D. Pshenichnyi 20 Jun. 1968 10 p refs Transl. into ENGLISH from Energomashinostroenie (Moscow), v. 12, no. 12, Dec. 1966 p 20–22

(CE-TRANS-4755) Available from Natl. Lending Library, Boston Spa, Eng.

The optimum nozzle angle was determined for the case of a large number of stages. For an impulse stage on its own, the optimum outlet angle for a nozzle with plane end walls is 8° to 10°; for an intermediate stage with full utilization of the outlet energy, the efficiency differs little from the optimum for angles of 8° to 14°, which makes it possible to obtain a wide output range by altering the blade angles only. Author

N68-32905 Avco Corp., Wilmington, Mass. Missile Systems Div.

DISPLACEMENT INTERACTION AND FLOW SEPARATION ON CONES AT INCIDENCE TO A HYPERSONIC STREAM

Torstein K. Fannelop and George D. Waldman Paris, France AGARD [1968] 25 p refs Presented at the Specialists' Meeting on Hypersonic Boundary Layers and Flow Fields, London, 1–3 May 1968

(Contract F04694-67-C-0060)

(AGARD-Paper-21)

A theoretical analysis is presented for the boundary-layer flow about a blunted cone at incidence to a hypersonic stream. The boundary-layer problem is formulated in terms of streamline coordinates and the equations which result are solved exactly by means of an implicit finite-difference procedure. Methods available for solving the three-dimensional inviscid flow field are examined and found to be inefficient relative to the present boundary-layer method. A semi-empirical method for calculating the inviscid surface pressure rapidly and accurately is presented together with details of the corresponding streamline tracing procedure. The method can account for changes in the local inviscid pressure due to boundary layer displacement effects. Converged solutions of the displacement pressure interaction problem are obtained by coupling the boundary layer and inviscid methods in a step-by-step iteration procedure. The effects of displacement interation are particularly important on the leeward side. The relationship between these effects and incipient separation is discussed. Author

N68-32938# Air Force Systems Command, Wright-Patterson AFB, Ohio. Air Force Flight Dynamics Lab.

A SIMPLE AERODYNAMIC RULE FOR HYPERSONIC SMALL DISTURBANCE FLOWS Technical Report, May–Dec. 1967

Donald J. Harney Mar. 1968 22 p refs

(AFFDL-TR-68-4; AD-671500)

A revival of interest in perfect gas hypersonic small disturbance theory is brought about by the practical possibilities of hypersonic vehicles whose slenderness, combined with the high altitude environment, makes the frozen flow, perfect gas assumption reasonable. In many cases of experimental slender body aerodynamics the predominant effect of reacting real gases is associated not with the flow over a model but rather with nonequilibrium effects in the hypersonic nozzle of high energy wind tunnels. Primarily to eliminate problems associated with wide variations and mismatch of Mach number and additional difficulties in the accurate measurement of Mach number in high energy facilities a rule is developed for the pressure coefficient for hypersonic small disturbance flows in which neither the Mach number nor the hypersonic similarity parameter appears explicitly. The solutions which result, generalized to planar and axisymmetric flows by the tangent-wedge and tangent-cone theories, accurately approximate the inherent nonlinearities of hypersonic flow for M(tau) > or = 1, a region where classical hypersonic similarity is most important. However, the need to invoke similarity is eliminated by the availability of practical solutions. The only requirements for correlating two different inviscid flow situations over similar bodies are that gamma be known but need not necessarily be the same and that both satisfy the usual limitations of hypersonic small disturbance theory. Author (TAB)

N68-33010# Southampton Univ. (England). Inst. of Sound and Vibration Research.

ORIGINS OF COMPRESSOR NOISE

P. E. Doak Feb. 1968 12 p Presented at the Symp. on Aeron. Acoustics, Toulouse, 6–8 Mar. 1968

CFSTI: HC $3.00/MF $0.65

Investigations on a model axial compressor have shown that the discrete frequency noise of a single fan rotor row can be, in effect, totally eliminated. Also it is possible to estimate the discrete frequency noise produced by the rotor when wakes are present from upstream supports or relatively distant stators. The broad-band noise components from vortex shedding and from oncoming turbulence can be predicted, approximately. The level of broadband noise due to vortex shedding only is significantly below overall noise levels predicted for fans by standard empirical formulas. Thus an indication can be given of effective minimum noise levels from well-designed fans. Author

N68-33043*# Bell Aerosystems Co., Buffalo, N. Y.

A GENERALIZED EXPERIMENTAL INVESTIGATION OF HOT GAS RECIRCULATION AND INGESTION FOR JET VTOL AIRCRAFT

Patrick E. Ryan, Richard J. Heim, and Wayne J. Cosgrove Washington NASA Sep. 1968 150 p refs

(Contract NAS1-6706)

(NASA-CR-1147) CFSTI: HC $3.00/MF $0.65 CSCL 21E

Results of a small scale experimental investigation into the engine inlet temperature rise and flow field caused by the recirculating hot exhaust gases from various simulated V/STOL jet engine arrangements in static proximity to ground are presented. Experimental data were obtained to evaluate the recirculating flow field and engine inlet temperature rise caused by hot exhaust jets impinging on the ground. The effect of engine spacing, height, exhaust deflection angle, exhaust nozzle geometry, and wing planform are included. Author

N68-33081*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

A COMPUTER PROGRAM FOR SYSTEMATICALLY ANALYZING FREE-FLIGHT DATA TO DETERMINE THE AERODYNAMICS OF AXISYMMETRIC BODIES

Gerald N. Malcolm and Gary T. Chapman Washington Sep. 1968 39 p refs

(NASA-TN-D-4766) CFSTI: HC $3.00/MF $0.65 CSCL 01A

The computer program analyzes free-flight motions to deduce coefficients of drag, lift, and static and dynamic stability from any set of free flight data complete enough to define the trajectory and angle history. Nonlinear behavior can be accurately assessed from the results of the data reduction program, and available methods are discussed. To demonstrate the effectiveness of the data reduction method, free flight tests of the AGARD standard hypersonic ballistic correlation model HB-2 were conducted. The results for lift and static and dynamic stability at a Mach number of 2 agreed well with conventional wind tunnel results. Significant differences were found in the drag data because of different base pressures believed due to sting effects in the wind tunnel tests. Author

N68-33217# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

JOURNAL OF COMPUTER MATHEMATICS AND MATHEMATICAL PHYSICS, VOLUME 6, NO. 6, 1966 (SELECTED ARTICLES)

4 Oct. 1967 34 p refs Transl. into ENGLISH from Zh. Vychislitel'noi Mat. i Mat. Fiz. (Moscow), v. 6, no. 6, 1966 p 1064–1081, 1119–1127

(FTD-MT-24-216-67; AD-670294)

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N68-33218# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

ALGORITHMS OF NUMERICAL DIAGRAMS OF THE METHOD OF INTEGRAL RELATIONSHIPS FOR CALCULATING MIXED GAS FLOWS [ALGORITMY CHISLENNYKH SKHEM METODA INTEGRAL'NYKH SOOTNOSHENIY DLYA RASCHETA SMESHANNYKH TECHENIY GAZA]

O. M. Belotserkovskiy, A. Bulekbayev, and V. G. Grudnitskiy *In its* J. of Computer Math. and Mathematical Phys., vol. 6, no. 6, 1966 4 Oct. 1967 p 1–19 refs (See N68-33217 20-01)

The application of numerical techniques are discussed for the solution of the problem of supersonic flow past blunt bodies by the method of integral relations. The problem consists of determining the single-valued and continuous solution for the region of minimum effect of bluntness with boundaries formed by the shock wave. Three different schemes of the method of integral relations are outlined for which the construction of three algorithms are presented. The first one was constructed for supersonic flows past axisymmetric bodies with equilibrium dissociation taken into account. The second construction considered supersonic real gas flows past blunt bodies, with nonequilibrium dissociation taken into account. The third was constructed using double approximation according to scheme, then integrating and approximating. It is said that due to the difficulties in obtaining analytical evaluations of the accuracy and convergence of the method of integral relations, the basic criterion should be numerical evaluation. Calculations in various approximations were carried out for each of the three schemes for a sphere at M = 10. Author

N68-33219# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

ON ONE CLASS OF SELF-SIMILAR MOTIONS OF RELAXING GAS [OB ODNOM KLASSE AVTOMODEL'NYKH DVIZHENIY RELAKSIRUYUSHCHEGO GAZA]

O. Yu. Polyanskiy and N. G. Lebedeva *In its* J. of Computer Math. and Mathematical Phys., Vol. 6, No. 6, 1966 4 Oct. 1967 p 21–29 refs (See N68-33217 20-01)

One-dimensional self-similar motion of a relaxing gas displaced by a piston according to an exponential law is considered. Gas dynamic parameters of the flow field between the piston and shock wave are calculated from a system of ordinary differential equations describing one-dimensional, unsteady flows of relaxing gas which allows a certain class of self-similar solutions under certain assumptions. The applicability of the results to investigation of hypersonic relaxing gas flows past slender sharp-nosed bodies is considered by using the hypersonic equivalence principle. Author

N68-33230*# General Motors Corp., Indianapolis, Ind. Allison Div.

AXIAL FLOW COMPRESSOR DESIGN COMPUTER PROGRAMS INCORPORATING FULL RADIAL EQUILIBRIUM. PART 1: FLOW PATH AND RADIAL DISTRIBUTION OF ENERGY SPECIFIED (PROGRAM 2)

H. F. Creveling and R. H. Carmody Jun. 1968 228 p refs

(Contract NAS3-7277)

(NASA-CR-54532; EDR-5845) CFSTI: $3.00 CSCL 01A

A compressor aerodynamic design program was developed to account for complete radial equilibrium of flow and to evaluate losses on the basis of blade element loss prediction methods. Radial distribution of energy is specified as a polynomial variation of whirl velocity at the exit of each rotor blade row; rotor tip loadings are specified as are limiting values of rotor hub relative exit angles, stator hub Mach numbers, stator hub loadings, and the compressor flow path. The blockage factor is specified as the unblocked fraction of annulus area at the hub and casing of each axial station. The program user specifies a desired overall mass-averaged pressure ratio and provides data for a maximum number of stages, not to exceed twelve. Author

N68-33285# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

SEPARATION FLOW AROUND A VIBRATING PROFILE [SRYVNOYE OBTEKANIYE KOLEBLYUSHCHEGOSYA PROFILYA]

V. A. Uspenskiy *In its* News of Inst. of Higher Learning, Aeron. Eng., No. 1, 1966 2 Oct. 1967 p 31–41 refs (See N68-33261 20-23)

The article proposes an analytic solution of the problem of determination of aerodynamic forces acting on a harmonically vibrating thin profile streamlined by a plane-parallel flow of incompressible ideal liquid with break-away. Results of the work can be used in calculation of the stall flutter of aircraft propellers and helicopter rotors, and by extension of the solution to a profile grid, in determining the critical speeds of turbines. Author

N68-33374*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

EXPERIMENTAL INVESTIGATION OF THE DYNAMIC RESPONSE OF A SUPERSONIC INLET TO EXTERNAL AND INTERNAL DISTURBANCES

Joseph F. Wasserbauer and Daniel L. Whipple Washington Sep. 1968 28 p refs

(NASA-TM-X-1848) CFSTI: HC$3.00/MF$0.65 CSCL 01A

The terminal shock position and static-pressure responses of an inlet were measured at a Mach number of 3.0 in the 10-by 10-foot supersonic wind tunnel. Internal and external disturbances were investigated over frequency ranges of 0.3 to 200 and 0.1 to 12 Hz, respectively. For an internal disturbance, the dynamic response of the terminal shock and static pressure near the inlet throat exhibited a lag characteristic to about 40 Hz but encountered resonant conditions at about 85 and 180 Hz. For the external

disturbance, the dynamic response of the terminal shock and static pressure near the inlet throat exhibited a lead characteristic. Author

N68-33383 California Univ., Davis.
AERODYNAMIC THROTTLING AND JET PENETRATION
Robert Harry Nunn (Ph.D. Thesis) 1967 75 p
Available from Univ. Microfilms: HC $4.00/MF $3.00 Order No. 67-14983

Aerodynamic throttling is the process by which the flow of a fluid through a duct is throttled by a secondary flow, at an angle to the first. The effect of the secondary flow (jet) on the mainstream flow is studied both analytically and experimentally. In the analysis, the equations of motion and continuity, expressed in orthogonal curvilinear coordinates, are solved with the assumptions that the jet is thin and that viscous and turbulent transport mechanisms are negligible in the initial region of the jet/mainstream interaction. In the incompressible case these solutions are obtained in closed form. When the flow is compressible it is necessary to consider the effects of shock waves occurring along the jet. Experimental data are obtained using an air blowdown system with a throat size of 1 inch by 1 inch. Dissert. Abstr.

N68-33451*# Rice Univ., Houston, Tex.
CONICAL BODIES OF GIVEN LENGTH AND VOLUME HAVING MAXIMUM LIFT-TO-DRAG RATIO AT HYPERSONIC SPEEDS. VARIATIONAL METHODS
Ho-Yi Huang Washington NASA Aug. 1968 29 p refs
(Grant NGR-44-006-063)
(NASA-CR-1156; Rept.-36) CFSTI: HC $3.00/MF $0.65 CSCL 01A

An investigation of the lift-to-drag ratio attainable by a slender, conical body flying at hypersonic speeds is presented under the assumptions that the pressure distribution is modified Newtonian and the surface-averaged friction coefficient is constant. Length and volume are given, and the values of the free-stream dynamic pressure, the factor modifying the Newtonian pressure distribution, and the surface-averaged friction coefficient are known *a priori*. The indirect methods of the calculus of variations are employed, and numerical solutions are found using an IBM 7040 computer. It is found that a one-parameter family of external solutions exists, the parameter being the dimensionless area S^*. It is also noted that the geometry of the optimum contour and the maximum value of the modified lift-to-drag ratio E^* are uniquely related to the dimensionless area S^*. Author

N68-33468# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
EXPERIMENTAL DETERMINATION OF DRAG FACTOR FOR A SPHERE IN A SUPERSONIC RAREFIED GAS FLOW [EKSPERIMENTAL'NOYE OPREDELENIYE KOEFFITSIYENTA SOPROTIVLENIYA SHARA V SVERKHZVUKOVOM POTOKE RAZPREZHENNOGO GAZA]
V. A. Sukhnev 29 Aug. 1967 9 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Mekh. (USSR) no. 3, 1965 p 172-175
(FTD-HT-67-174; AD-671585)

A large number of experiments were conducted in a low density wind tunnel to determine the drag coefficient of a sphere in the Mach and Reynolds number range $3.6 < M < 6.0$, $2 < R < 500$. The sphere surfaces were highly polished; the diameters varied between 1 and 14 mm. A special effort was made to determine the effect of model support (sting) on the total shere drag. This was done by two sets of experiments. First, the total moment on the sphere was measured including the support and secondly, the drag was measured with the support flush with, and separated from the model. The experimental data obtained in this manner showed that the effect of the sting on the drag C sub x was of order 3-5% for a sting-to-sphere diameter ratio of 0.1. The effect of surface roughness on C sub x was tested by scratching the sphere surface. Within the experimental accuracy no effect could be observed on the sphere drag coefficient due to such surface roughness. Author (TAB)

N68-33499*# Pratt and Whitney Aircraft, East Hartford, Conn.
EXPERIMENTAL EVALUATION OF TRANSONIC STATORS, DATA AND PERFORMANCE REPORT, MULTIPLE-CIRCULAR-ARC STATOR A
M. J. Keenan, K. G. Harley, and G. A. Bogardus 1968 165 p refs
(Contract NAS3-7614)
(NASA-CR-54621; PWA-3260) CFSTI: $3.00 CSCL 01A

A transonic stator, having multiple-circular-arc airfoils with minimum curvature at the forward portion of the airfoil consistent with flow-choking limitations, was tested over a range of flow angles and velocities. The transition point of the airfoil section was located at an assumed shock location. Stator inlet flow was generated by means of an inlet guide vane and flow generation rotor. Transonic stator inlet flow was achieved at design speed, but Mach numbers were slightly lower than the design values. Measured minimum stator losses at mid-span were lower than the NASA loss correlation for comparable Mach numbers. Near the blade ends the losses increased sharply. At mid-span, the stator exhibited a minimum total pressure loss coefficient, at design speed. The inlet Mach number and diffusion factor at minimum loss were 0.91 and 0.53 respectively. Near the hub at 90 percent span, the stator minimum total pressure loss coefficient, inlet Mach number, and diffusion factor were 0.145, 1.00 and 0.63 respectively. At 10 percent span, the stator minimum total pressure loss coefficient, inlet Mach number and diffusion factor were 0.098, 0.84 and 0.50 respectively. At design speed, optimum stator incidence occurred at zero degrees to the suction surface at all radial stations except at 90 percent span, where minimum losses occurred at positive incidences. Author

N68-33500*# Pratt and Whitney Aircraft, East Hartford, Conn.
EXPERIMENTAL EVALUATION OF TRANSONIC STATORS, DATA AND PERFORMANCE REPORT, MULTIPLE-CIRCULAR-ARC STATOR B
M. J. Keenan and J. A. Bartok 1968 119 p refs
(Contract NAS3-7614)
(NASA-CR-54622; PWA-3356) CFSTI: $3.00 CSCL 01A

A transonic stator, having multiple-circular-arc airfoils with minimum curvature at the forward portion of the airfoil consistent with flow choking limitations, was tested over a range of flow angles and velocities. The transition point of the airfoil section was located rearward of an assumed shock location. Stator inlet flow was generated by means of an inlet guide vane and flow generation rotor. Transonic stator inlet flow was achieved at design speed, but Mach numbers were slightly lower than the design values. Measured minimum stator losses at mid-span were lower than the NASA loss correlation for comparable Mach numbers. Near the blade ends the losses increased sharply. At mid-span the stator exhibited a minimum total pressure loss coefficient, at design speed. The inlet Mach number and diffusion factor at minimum loss were 0.92 and 0.53, respectively. Near the hub at 90 percent of span, the stator minimum total pressure loss coefficient, inlet Mach number and diffusion factor were 0.15, 1.00 and 0.64, respectively. At 10 percent of span, the stator minimum total pressure loss coefficient, inlet Mach number and diffusion factor were 0.11, 0.86 and 0.52, respectively. At 5 and 95 percent of span, the stator minimum total pressure loss coefficients were 0.21 and 0.25, respectively. Test data are presented to show the variation of deviation, diffusion factor and stator loss coefficient as a function of incidence angle. Author

N68-33501*# Pratt and Whitney Aircraft, East Hartford, Conn.
EXPERIMENTAL EVALUATION OF TRANSONIC STATORS, DATA AND PERFORMANCE REPORT, DOUBLE-CIRCULAR-ARC STATOR
M. J. Keenan and J. A. Bartok 1968 16 p refs
(Contract NAS3-7614)
(NASA-CR-54823; PWA-3404) CFSTI: $3.00 CSCL 01A

A transonic stator having double-circular-arc airfoils was tested over a range of flow angles and velocities. Stator inlet flow was generated by means of an inlet guide vane and flow generation rotor. Transonic stator inlet flow was achieved at design speed. Measured minimum stator losses at mid-span were lower than the NASA loss correlation for comparable Mach numbers. Near the blade ends the losses increased sharply. At mid-span the stator exhibited a minimum total pressure loss coefficient, at design speed. The inlet Mach number and diffusion factor at minimum loss were 0.94 and 0.53, respectively. Near the hub at 90 percent of span, the stator minimum total pressure loss coefficient, inlet Mach number and diffusion factor were 0.147, 1.02 and 0.62, respectively. At 10 percent of span, the stator minimum total pressure loss coefficient, inlet Mach number and diffusion factor were 0.114, 0.87 and 0.50, respectively. At 5 and 95 percent of span, the stator minimum total pressure loss coefficients were 0.22 and 0.24, respectively. At design speed, minimum loss occurred at approximately 2 degrees negative incidence to the suction surface, except near the hub where minimum loss occurred at positive incidences. Test data are presented to show the variation of deviation, diffusion factor and stator loss coefficient as a function of incidence angle. Author

N68-33556 California Inst. of Tech., Pasadena.
A CLASS OF THREE DIMENSIONAL OPTIMUM WINGS IN HYPERSONIC FLOW
Tse-Fou Zien (Ph.D. Thesis) 1967 124 p
Available from Univ. Microfilms: HC $6.00/MF $3.00 Order No. 67-14368

The idea of using streamlines of a certain known flow field to construct generally three-dimensional lifting surfaces together with the method of evaluating the aerodynamic forces on the surfaces, developed by Nonweiler, Jones and Woods, has been extended and applied to axisymmetric hypersonic flow fields associated with a class of slender power-law shock waves of the form $r = rx^n$ in the limit of infinite free stream Mach number. For this purpose, the basic flow fields associated with concave shocks ($n > 1$) have first been calculated numerically at a fixed value of the ratio of specific heats $\gamma = 1.40$ and the results are presented in tabulated form, covering a wide range of values of n. The method of constructing a lifting surface either by prescribing its leading edge shape on the basic shock or by specifying its trailing edge shape in the plane $x = 1$ is then discussed. Dissert. Abstr.

02 AIRCRAFT

Includes fixed-wing airplanes, helicopters, gliders, balloons, ornithopters, etc; and specific types of complete aircraft (e.g., ground effect machines, STOL, and VTOL); flight tests; operating problems (e.g., sonic boom); safety and safety devices; economics; and stability and control. For basic research see: 01 Aerodynamics. For related information see also: 31 Space Vehicles; and 32 Structural Mechanics.

N68-32190# Boeing Co., Renton, Wash. Commercial Airplane Div.
THE REDUCTION OF FAN NOISE IN TURBO-FAN ENGINES BY USE OF ACOUSTICAL LININGS. VOLUME 1: SUMMARY OF THEORETICAL AND EXPERIMENTAL DATA
A. O. Andersson, A. J. Bohn, and R. A. Mangiarotty 24 Oct. 1967 111 p refs Previously X68-18469
(D6-17100, V. 1) CFSTI: $3.00

Initial results and conclusions are presented on a program to develop theoretical methods and experimental techniques leading to a better understanding of the technology for acoustical treatment of engine fan ducts. Theoretical prediction methods are being used for lining optimization studies, and sufficient experimental data have been acquired to compile acoustical design criteria for treating engine fan ducts. Some correlation has been obtained between laboratory flow duct and full scale engine duct acoustical performance. Existing acoustical materials are being evaluated, and an analog computer technique has been developed for determining the desirable characteristics of lining materials. A new nonmetallic lining material, polyimide resin glass fiber, is being developed and some evaluation has been completed. Author

N68-32191# Boeing Co., Renton, Wash. Commerical Airplane Div.
THE REDUCTION OF FAN NOISE IN TURBO-FAN ENGINES BY USE OF ACOUSTICAL LININGS. VOLUME 2: DETAILED THEORETICAL AND EXPERIMENTAL DATA
A. O. Anderson, A. J. Bohn, and R. A. Mangiarotty 24 Oct. 1967 152 p refs Previously X68-18452
(D6-17100, V. 2) CFSTI: HC $3.00/MF $0.65

This volume consists of the appendices to N68-32190. The data presented were analyzed and reduced from the bulk of the test data in the experiments and theoretical analyses. Author

N68-32192# Boeing Co., Renton, Wash. Commercial Airplane Div.
ACOUSTIC AND THRUST CHARACTERISTICS OF THE SUBSONIC JET EFFLUX FROM MODEL SCALE SOUND SUPPRESSORS. PART 1: UNHEATED JETS, VOLUME 2
R. A. Mangiarotti and D. Elizabeth Cuadra 27 Dec. 1967 141 p refs
(D6-15071, V. 2) CFSTI: $3.00

Acoustic near and far field data and thrust characteristics are presented for four model nozzle configurations. A smooth-walled conical nozzle serves as a reference model; comparison models include a rough-walled conical nozzle, the Boeing 21-tube suppressor nozzle, and a 12-fluted nozzle. Using unheated air, these nominally tenth-scale (6 square-inch exit area) nozzles were tested for their noise generation characteristics for exit Mach numbers $0.5 \leq M_j \leq 0.9$ and for their thrust characteristics for exit Mach numbers $0.2 \leq M_j \leq 0.8$. (See Volume 1, N68-32196.) Author

N68-32193# Boeing Co., Renton, Wash. Airplane Div.
INTERIM PREDICTION METHOD FOR THE ACOUSTIC FAR FIELD OF EJECTORS
D. Elizabeth Cuadra 2 Aug. 1968 39 p refs
(D6-17093TN)

A far field acoustic prediction method is recommended for the broadband jet noise of ejectors for the cases of fully mixed flows and unmixed flows, together with shroud length criteria for complete mixing. The beginning of a method for partially mixed flows is also indicated, but additional knowledge, on both mean flow properties and turbulence properties is needed to make it workable. Author

N68-32194# Boeing Co., Renton, Wash. Airplane Div.
LIMITED COMPRESSOR NOISE SURVEY: ANALYSIS OF TEST RESULTS
J. A. Crim and R. E. Russell 25 May 1968 48 p refs
(D6-11226TN) CFSTI: HC $3.00/MF $0.65

An exploratory research program was carried out to investigate possible causes of fan and compressor noise. Several ideas had

been advanced with respect to the source of this noise. The experiments, carried out on a 5.3-inch diameter fan, were aimed at quickly testing these theories, and at finding promising methods of reducing the noise. The results are not quantitatively applicable to a full size fan. However, there is reason to believe that the qualitative trends will be present in larger fans. The following five basic areas of noise generation were investigated: (1) upstream turbulence, (2) rotor tip flow field, (3) rotor loading (4) rotor/inlet guide vane spacing, and (5) inlet guide wave treatment. The two most promising means of reducing fan noise are rotor unloading and injecting air out the trailing edge of the inlet guide vanes. Author

N68-32195# Boeing Co., Renton, Wash. Airplane Div.
INTERNAL SUPPRESSION OF COMPRESSOR NOISE OF THE JT3D-3B ENGINE WITH 3/4 LENGTH FAN DUCTS
A. J. Bohn 6 May 1966 63 p Revised
(T6-3498, Rev. A) CFSTI: $3.00

Acoustic treatment of internal surfaces of the inlet and 3/4 length fan ducts of the JT3D-3B engine were tested. Effects of variations in treatment design, length of treated section, areas of treatment and depth of backing space within the fan ducts were studied. The treatment design tested in the inlet duct had no measurable effect on engine noise. Treated 3/4 length fan ducts reduced peak flyover noise (calculated for 200 foot altitude) by from one PNdb at 4000 lbs static thrust up to 7 PMdb at 15,000 lbs static thrust, and by 4 PNdb at maximum static thrusts. The effectiveness of a unit area of treatment in the fan duct varied nonuniformly with its location within the duct. Consequently, no relicble measure of attenuation in terms of a nondimensional ratio such as L/d (length of treatment over depth or diameter of duct) could be deduced for application to other engines. Author

N68-32196# Boeing Co., Renton, Wash. Airplane Div.
VELOCITY AND SHEAR PROFILES IN THE SUBSONIC JET EFFLUX FROM MODEL SCALE SOUND SUPPRESSORS. PART 1: UNHEATED JETS, VOLUME 1
James A. Ranner and D. Elizabeth Cuadra 14 Mar. 1966 111 p refs
(D6-15071, V. 1) CFSTI: $3.00

Mean velocity and shear patterns throughout the major noise generating regions of the jet efflux from four nozzle configurations are described. A smooth-walled conical nozzle serves as a reference model; comparison models include a rough-walled conical nozzle, the Boeing 21-tube suppressor nozzle, and a slotted nozzle based on the Rolls-Royce suppressor. Using unheated air, these nominally tenth scale (6 square-inch exit area) nozzles were tested for exit Mach numbers ranging from 0.1 to 1.75. Implications regarding the sound generation are discussed. (See Volume 2, N68-32192.) Author

N68-32197# Boeing Co., Renton, Wash. Airplane Div.
PNDB GROUND CONTOUR DETERMINATION FOR JET AIRCRAFT
J. V. O'Keefe 18 Mar. 1966 37 p refs Revised
(D6-15082TN, Rev. A) CFSTI: $3.00

Procedures are outlined for determining maximum jet noise levels for ground static and flight conditions. A method for defining ground contour iso-PNdB lines for a specific engine-airplane match and an assigned flight profile is provided. Jet noise level predictions are in terms of full octave band sound pressure levels of ground-to-ground sideline noise or air-to-ground sideline or fly-over noise. These values may be converted to overall sound pressure levels (OA-SPL) or a subjective rating of perceived noise levels (PNdB). Author

N68-32198# Boeing Co., Renton, Wash. Airplane Div.
PROCEDURES FOR JET NOISE PREDICTION
M. B. Mc Kaig, R. H. Sawhill, and John B. Large 11 Mar. 1965 29 p refs Revised
(D6-2357TN, Rev. A) CFSTI: $3.00

Calculation procedures are provided for predicting maximum flyby noise from jet aircraft exhausts. Three types of engine exhausts are considered: turbojet with standard circular nozzle; turbojet with nonstandard nozzle; and turbofan or bypass engine with unmixed exhausts or completely mixed exhausts. Noise predictions are in terms of octave-band sound pressure levels of maximum air-to-ground flyby noise or of maximum ground-to-ground sideline noise. These levels may be converted to an overall sound pressure level or to a subjective rating such as perceived noise level. Author

N68-32199# Boeing Co., Renton, Wash. Airplane Div.
FAN-DISCHARGE NOISE SUPPRESSOR TEST JT8D ENGINE
M. B. Mc Kaig 28 Oct. 1964 47 p
(T6-3166) CFSTI: $3.00

To determine if suppression of fan-discharge noise is feasble in the high-velocity duct system of a turbofan engine, an acoustically treated extension of the fan discharge duct of a JT8D engine was tested. Engine thrusts ranged from 4000 to 13,500 pounds (maximum static). More than 20 db attenuation of discrete-frequency spike noise was obtained. White noise between spikes also was reduced as much as 8 db. It is concluded that acoustic lining in high-velocity air ducts can give useful amounts of attenuation, and that application of the technique to turbofan engines is promising because of the large proportion of high-frequency noise discharged from the fan duct. Author

N68-32200# Boeing Co., Renton, Wash. Transport Div.
J-75 INLET NOISE SUPPRESSION TEST
M. B. Mc Kaig 27 Oct. 1964 60 p
(T6-3173) CFSTI: $3.00

Three devices were tested on a J-75 turbojet engine for reducing compressor or fan noise radiated from the inlet: (1) sonic throat, (2) absorbent inlet lining, and (3) absorbent inlet guide vanes. The basic inlet design simulated a supersonic inlet with expandable spike. The first device, the sonic throat, was formed by setting the spike in its fully expanded, supersonic-cruise position, and then advancing the throttle until choking occurred. The absorbent inlet lining consisted of acoustic material extending along the inside of the barrel for a length of about one diameter. The absorbent guide vanes, 20 in number, were placed directly upstream of the engine's fixed inlet guide vanes. The most effective single device was the choked inlet, delivering 10 to 15 PNdB. Conflicting results were obtained as to the relative merits of the inlet lining and inlet guide vanes, but they were probably about equally effective, giving around 3 PNdB. Author

N68-32201# Boeing Co., Renton, Wash. Airplane Div.
ATTENUATION OF AUXILIARY POWER UNIT (APU) EXHAUST NOISE BY STACK INSERT DEVICES
V. E. Calloway 12 Aug. 1964 18 p
(T6-3160) CFSTI: HC $3.00/MF $0.65

Attenuation of 727 auxiliary power unit exhaust noise provided by stack insert devices are presented. The combination of an in-line flow-through muffler and an exhaust deflector was found to be the most effective method of reducing this noise. These two devices complement each other in their attenuation properties; the deflector devices reduce levels in frequencies below 300 cps by 2 to 7 dB, while the muffler reduces speech interference level frequencies (600-4800 cps) by 4 to 8 dB. Author

N68-32202# Boeing Co., Renton, Wash. Airplane Div.
AIRCRAFT ACOUSTICS: COMMUNITY NOISE PREDICTION
K. Fukushima 2 Jul. 1964 70 p refs
(D6-4219TN) CFSTI: $3.00

A computer program was written specifically to determine the following: (1) The community noise level expected at an airport, given the take-off (normal and power cutback) or landing path of the aircraft, its engine noise level and parameter governing attenuation of the radiated engine noise. (2) The geographical plot of ground noise level, varying time, the point of the aircraft's break release and the chosen flight path. Author

N68-32203# Boeing Co., Renton, Wash. Transport Div.
COMMUNITY NOISE LEVELS FOR VARIOUS AIRCRAFT DURING TAKE-OFF AND LANDING
R. D. Hulsey 5 Feb. 1964 21 p refs
(D6-9375TN) CFSTI: $3.00

Data from many sources were gathered and processed to obtain noise as a function of altitude for the take-off and landing approaches of various airplanes. The purpose here is to present, in one central document, material that can be used for aircraft noise comparisons at a later date and thus eliminate the confusion that usually arises from multiple sources of information. Author

N68-32204# Boeing Co., Renton, Wash. Transport Div.
PROCEDURE FOR ANALYZING DATA FROM UNCONTROLLED FLY-BY TESTS
M. B. McKaig 1 Oct. 1963 37 p
(D6-9815TN) CFSTI: $3.00

Analysis of acoustic data from fly-by tests offers special difficulties when the basic flight conditions are uncontrolled; from test to test there may be variations of speed, altitude, flight path, and weather conditions. The effects of these variables on the recorded sound may make direct comparison of results very misleading. A procedure is set forth for reducing these effects, by referring recorded sounds to the airplane's orientation with respect to the observer at the time the sounds originated; the sound levels are then corrected to standard conditions of distance and weather. Author

N68-32205# Boeing Co., Renton, Wash. Transport Div.
GRAPHICAL DETERMINATION OF COMMUNITY-NOISE CONTOUR COORDINATES
Merle B. McKaig 28 Jun. 1963 28 p
(D6-9582TN) CFSTI: $3.00

A graphical method is presented for determining the location in a community of the peak-noise contour lines expected from operation of a given type of aircraft from a nearby airport. Two variations of the method are included: how to show the effects of cut-back, and how to determine the peak level to be expected at a given ground location. Steps in the presentation are given in enough detail that users of the method need not have extensive technical training. Author

N68-32206# Boeing Co., Renton, Wash. Transport Div.
THE DESIGN AND CONSTRUCTION OF AN ANNOYANCE SCALE FOR JET ENGINE NOISE
Stanley J. Rule 23 Jan. 1963 62 p refs
(D6-4348) CFSTI: $3.00

A research program is described on the development of a human reaction scale for airplane noise. Such a scale is useful in determining the relative effects of noise reduction procedures on human comfort. The annoyance scale has been found to be applicable in the SPL range 60 to 100 db to broadband noises which do not contain discrete components. A scaling relationship has been developed which permits an annoyance equivalence to be established between broadband noise and impulse noise. Author

N68-32207# General Applied Science Labs., Inc., Westbury, N. Y.
INLET NOISE
Simon Slutsky Renton, Wash. Boeing Co. 25 Oct. 1962 55 p Prepared for Boeing Co., Renton, Wash.
(D6-4241) CFSTI: $3.00

Three mechanisms have been found to be of importance in inlet attenuation or transmission. The first involves the phenomenon of wave propagation cut-off frequencies experienced by spiral progressive waves below which rapid attenuation occurs. The second is the generation of waves as a result of interference of the rotor and stator blades. The third mechanism involves a technique of acoustic noise attenuation based on the use of thin porous diaphragms instead of the usual thick absorptive materials. An analysis of the far field of the inlet for the engine at rest is described. Author

N68-32208# Boeing Co., Renton, Wash. Transport Div.
ACOUSTIC ENERGY GENERATION AS A FUNCTION OF TURBOFAN ENGINE DESIGN
Harry Garmanian 21 Jun. 1962 92 p
(D6-9045) CFSTI: HC $3.00/MF $0.65

A program was initiated to cover experimental and analytical investigation of the performance of the variable exhaust geometry in a bypass engine in terms of jet noise attenuation and engine design criteria. The experimental portion of the program, a series of scale-model tests simulating exhaust flow conditions of a coplaner and partially mixed discharge configuration of the JT3D-1 and JT8D-1 turbofan engines, was conducted in the Model Jet Facility. The analytical part of the program was confined to a prediction of the acoustic potential of a fully-mixed discharge configuration of the tested engine. Author

N68-32209# Boeing Co., Renton, Wash. Transport Div.
EXTERIOR SOUND CHARACTERISTICS OF THE 707-320B AIRPLANE
D. L. Bryan 11 Jun. 1962 44 p refs
(T6-2418) CFSTI: $3.00

Acoustics tests were conducted so that the exterior sound characteristics of the Model 320B airplane during various in-flight and ground operations could be determined. The airplane tested was a production Model 320B powered by Pratt and Whitney Model JT3D-3 engines. Sound levels were measured under the flight path of the airplane as it was flying over in level flight. Tests were also conducted during ground-static operation of a single engine at which time sound levels were measured on the ground around the engine. Sound characteristics are presented in the form of sound level tables, frequency-spectrum plots, subjective noise curves, and directivity plots. The maximum sound pressure level at a point on the ground 800 feet below the take-off flight path of the airplane operating at maximum take-off power is estimated to be 109 dB. The corresponding loudness level and perceived noise level would be 117 phons and 120 PNdB, respectively. Author

N68-32210# Boeing Co., Renton, Wash. Transport Div.
MEASUREMENT OF NOISE CONTAINING DISCRETE FREQUENCY COMPONENTS IN THE PRESENCE OF RANDOM NOISE SIGNALS
H. H. Taniguchi 18 Apr. 1962 32 p refs
(D6-8786) CFSTI: $3.00

The measurements of discrete frequency noise and the method of interpreting the data were studied. The study was initiated for the purpose of obtaining a greater understanding of noise measurements made when intense discrete frequency components are present in the noise spectrum. The emphasis is placed on measurements of noise originating from jet engines during ground (static) operations and on measurements taken on the ground during aircraft fly-over (transient) conditions. Special measurement

techniques are required for determining the time-average value of a discrete frequency signal. These techniques can be classified as (1) sampling process, whereby the rectified signal is integrated over a fixed time period, and (2) continuous process, whereby the rectified signal is continuously smoothed (with a low-pass filter) and the resultant level displayed on a level-recording device. Author

N68-32211# Boeing Co., Renton, Wash. Transport Div.
PARAMETRIC STUDY OF COMMUNITY NOISE LEVELS FOR VARIOUS ENGINE CYCLES AND WEIGHT FLOWS
Heinz E. Schoernich 20 Feb. 1962 149 p refs
(D6-8147) CFSTI: $3.00

Community noise levels are calculated for airplanes equipped with four power plants, either turbojet or turbofan. A comparison of the perceived noise levels of various weight flows and engine types reveals that the perceived noise level (1) increases with an increase in total weight flow for each engine type, (2) decreases with higher bypass ratios for the same total weight flow, (3) decreases with reduction in power for any engine and any weight flow, and (4) decreases with increase in altitude for any engine and any weight flow. The perceived noise levels presented cover a wide range of total weight flow and engine cycles and should suffice as first approximations for many future airplane configurations. In short, the results of the study can be used to determine the community noise levels for various airplane configurations. Airplane–power plant-matching, aerodynamic, and other studies will yield the altitudes above a community for various airplanes. These altitudes, together with the engine cycle and the engine size, will determine the community noise levels for the airplane to be studied so that the optimum configuration as far as the community noise is concerned can be found. Author

N68-32212# Boeing Co., Renton, Wash. Transport Div.
THE TRANSMISSION OF SOUND INSIDE ABSORBING DUCTS
Heinz E. Schoernich 22 Jan. 1962 80 p refs Previously X65-80645
(D6-8087) CFSTI: $3.00

Theoretical formulas and graphs are derived which can be used to calculate the attenuation in db per foot of duct length. Rectangular, cylindrical, and square ducts with one, two, or four absorbing walls are considered. Since the equations and graphs are cumbersome to use, approximations for the formulas are derived. It is shown that the perimeter for a given area must be as large as possible if maximum attenuation is to be obtained; therefore, a rectangular duct is more favorable than a circular duct. It is also shown that attenuation is increased when duct width is decreased. Diminishing wall impedance, maximum possible theoretical attenuation, and a method for simplifying the Morse attenuation charts are also discussed. All modifications necessary for the calculation are made so that effective attenuation constants can be calculated for flows over an absorbing liner. Author

N68-32213# Boeing Co., Renton, Wash. Transport Div.
A METHOD OF PREDICTING STATIC TURBOFAN FAR FIELD NOISE
Peh Sun Ku 4 Dec. 1961 64 p refs Previously N64-82461
(D6-7859) CFSTI: $3.00

The jet noise, the fan noise, and the compressor noise were first estimated separately. The resultant spectrum contributed by these three types of noise was obtained by superposition of the respective levels in the appropriate octave bands. As an illustration, the predicted static results for the CJ 805–23 engine indicated good agreement with the measured static results. The maximum deviation from the measured results was 6 db in the octave band levels while the agreement with measured CJ 805–23 data for over-all SPL was ±2 db. Considering the maximum estimated error of measurement of ±2 db, the method is believed to be reliable for qualitative estimating purposes. Author

N68-32214# Boeing Co., Renton, Wash. Transport Div.
COMPARATIVE EVALUATION OF ACOUSTICAL PERFORMANCE OF BASIC AND HUSH KIT VERSIONS OF PRATT AND WHITNEY JT3D-1 TURBOFAN ENGINES
A. M. MirSepasy 29 Sep. 1961 26 p refs
(T6-2111) CFSTI: $3.00

Acoustics tests were conducted so that the acoustical characteristics of the Pratt and Whitney modified JT3D-1 turbofan engine could be evaluated. The test airplane, a 720B, was equipped in turn with (1) Pratt and Whitney Aircraft basic JT3D-1 engines, and (2) Hush Kit modified version of the JT3D-1 engine. The maximum sound pressure level attenuation at a point on the ground 800 feet below the airplane's takeoff flight path, with engines at takeoff power, was 1 db. At the 3400 pound thrust condition, the modified engine afforded attenuations of up to 6 PNdb during the pre-overhead (approach) position of the airplane and at a flight altitude near 400 feet. The Hush Kit modification produced little or no octave band SPL attenuation in the directions of fan discharge noise propagation (approximately 130° from inlet axis), and the normal to the engine axis. Author

N68-32215# Boeing Co., Renton, Wash. Transport Div.
WHINE NOISE IN FAN DUCTS
J. H. Prindle 21 Jul. 1961 48 p Previously X65-80742
(D6-7538) CFSTI: $3.00

The form of the acoustic field developed in a duct by a whining fan is investigated. A basic result is that the modes which will be excited can be predicted by supposing the stator blades are the noise sources. The effects of sound—absorptive walls and of flow in the duct are discussed. Application of the results to the JT8D-1 engine leads to the prediction that lining one foot of the inlet duct should suppress inlet whine at least four or five decibels. Author

N68-32216# Boeing Co., Renton, Wash. Transport Div.
THE DESIGN AND EVALUATION OF AN AERODYNAMIC INLET NOISE SUPPRESSOR
L. Maestrello 12 Dec. 1960 39 p
(D6-5980) CFSTI: $3.00

An inlet model noise suppressor has been designed and successfully tested. The inlet consists mainly of a cylindrical duct with central movable plug. The plug controls the throat area ratio and, as a consequence, induces pressure, density, and velocity jumps across a section of the inlet; this discontinuity suppresses the sound radiated upstream from the compressor. The tests reveal that for an inlet Mach number below 0.5, the noise radiated along the inlet was propagated without attenuation; but as the Mach number increased, the noise decreased; it finally disappeared when the inlet Mach number reached 0.90. The total pressure losses for the scale model varied from 1 to 1.5 inches of mercury, depending on the operating inlet total pressure. Author

N68-32217# Boeing Co., Seattle, Wash.
THE ACOUSTIC NEAR FIELD OF A MODEL AIR JET SIMULATING VERTICAL TAKE-OFF
Stanley Oas 28 Jan. 1958 32 p refs
(D2-2463) CFSTI: $3.00

Detailed measurements were made in the acoustic near field of a supersonic cold air jet exhausting vertically downward onto a ground plane. In the free field, the distribution and power spectrum shape of the model noise field matched very closely that of a 130,000 lb thrust rocket motor, although the power and frequency scale factors did not agree with those based on scaling

methods in use. The distortion of the sound field by the ground plane showed the combined effects of sound reflection and the 90° deflection of the jet stream. At close proximity to the ground plane, a 4 db reduction of total radiated acoustic power was measured. The noise spectrum shape differed from the free field shape for all positions of the jet above ground up to and including 32 nozzle diameters. Author

N68-32218# Boeing Co., Seattle, Washington.
PROPAGATION AND MEASUREMENT OF JET NOISE
A. A. Evenson and N. M. Barr 20 Dec. 1957 46 p refs
(D6-2820) CFSTI: $3.00

To obtain consistent data with which to describe the noise fields of jet aircraft, it is shown that very stable conditions are prevalent just after dawn when winds are light and a temperature inversion exists. Three separate tests, conducted under such conditions, gave satisfactory results. Far-field noise measurements are often meaningless unless referred to a standard meteorological condition. Present knowledge does not permit normalization of data acquired under different meteorological conditions. Consistent data may be acquired under a narrow range of meteorological conditions which may be forecast and identified by a professional meteorologist. Author

N68-32219# Douglas Aircraft Co., Inc., Long Beach, Calif. Aircraft Div.
AERODYNAMIC LOSSES CAUSED BY POROUS FIBERMETAL
S. P. Patel May 1967 82 p
(DAC-33722) CFSTI: HC $3.00/MF $0.65

Tests to determine the aerodynamic losses caused by porous fibermetal were conducted in the low speed tunnel. Two fibermetal plates with different porosities (25-Rayl and 10-Rayl material) with 0.75 inch-deep air-cavity backing were tested. For comparison, a smooth solid plate was also tested. When the backing was an air cavity, the momentum–thickness ratios were minimum for zero pressure gradient across the plate. When various types of backings were used in the cavity, the momentum–thickness ratios had the same values as those for the zero pressure gradient. These minimum values were 1.3 for the 25-Rayl fibermetal and 1.6 for the 10-Rayl fibermetal. The high momentum losses for the fibermetals with air-cavity backing are due to the crossflow through the porous surface. Author

N68-32220# Douglas Aircraft Co., Inc., Long Beach, Calif. Aircraft Div.
SONIC FATIGUE DESIGN STUDIES OF NACELLE ACOUSTICAL TREATMENTS. STUDIES CONDUCTED BETWEEN MARCH 1966 AND MARCH 1967
R. L. Frasca May 1967 102 p refs
(DAC-33770) CFSTI: HC $3.00/MF $0.65

A series of sonic fatigue tests on acoustically-treated panel designs were conducted using the Douglas high intensity sound system. These tests were conducted in support of a program directed toward the study of turbofan engine nacelle modifications to minimize fan-compressor noise radiation. The results of these tests aided in evaluating the relative acoustic fatigue strength of the panel designs tested, and served as guidelines for designing similar structure to resist acoustically induced fatigue. Author

N68-32221# Douglas Aircraft Co., Inc., Long Beach, Calif. Structural Mechanics Section.
FLYOVER NOISE DURING TAKEOFF AND LANDING OF THE DC-9-30 AIRCRAFT
E. B. Fish May 1967 19 p
(DAC-33753 CFSTI: $3.00

Data are presented on measured noise levels and measured aerodynamic performance which are necessary to determine takeoff and landing flyover noise levels for airport communities during operation of the DC-9-30. Takeoff noise levels can be determined for full takeoff thrust departures and for departures with a special noise abatement thrust reduction. Noise levels below the landing flight path can be determined for a given landing gross weight for a given distance from touchdown. Author

N68-32222# Douglas Aircraft Co., Inc., Long Beach, Calif. Aircraft Div.
MEASURED FLYOVER NOISE LEVELS OF THE DC-8-62 POWERED BY JT3D-3B ENGINES WITH LONG FAN-DISCHARGE DUCTS
B. B. Adams Mar. 1967 56 p refs
(DAC-33676) CFSTI: HC $3.00/MF $0.65

The results of a program to measure flyover noise of the DC-8-62 powered by JT3D-3B engines with long duct pods are presented. The data are also applicable to the DC-8-63 equipped with the same engines. A description of the testing procedures, data analysis, and the final results are included. With the data presented, one can determine the noise levels on the ground below the aircraft for virtually any thrust condition which may be encountered in either takeoff or landing operations. Included are brief discussions of the test equipment, measurement procedures, and data reduction procedures, as well as a discussion of the techniques used to normalize the measured data points. Author

N68-32223# Douglas Aircraft Co., Inc., Long Beach, Calif. Aircraft Div.
MEASURED FLYOVER NOISE LEVELS OF THE DC-8 POWERED BY JT3D-3B ENGINES WITH SHORT FAN-DISCHARGE DUCTS
B. B. Adams 16 Dec. 1966 81 p refs
(DAC-33523) CFSTI: $3.00

The results of a program to measure the flyover noise of the DC-8 powered by JT3D-3B engines with short duct pods are presented. The data are applicable to the Series 55 and the Series 61 DC-8's. A description of the testing procedures, data analysis, and the final results are included. With the data presented, one can determine the noise levels on the ground below the aircraft for virtually any thrust condition which may be encountered in either takeoff or landing operations. Author

N68-32224# Douglas Aircraft Co., Inc., Long Beach, Calif. Aircraft Div.
MEASURED FLYOVER NOISE LEVELS OF THE DC-8 POWERED BY JJ3D-3B ENGINES WITH SHORT FAN-DISCHARGE DUCTS AND PROTOTYPE FAN-DISCHARGE DUCT SUPPRESSORS
B. B. Adams 16 Dec. 1966 90 p refs
(DAC-33524) CFSTI: $3.00

As a part of the program to reduce airport neighborhood noise levels a flyable prototype noise suppression system was developed for the JT3D-3B turbofan engine with short-duct engine pods. The noise suppression system consists essentially of the installation of sound absorbent surfaces in the fan-discharge ducts of the engine in place of the production surfaces of sheet aluminum. A brief discussion of the amount of noise reduction achieved by the suppressor is included. Author

N68-32225# Douglas Aircraft Co., Inc., Long Beach, Calif. Engineering Div.
FLYOVER NOISE DURING TAKEOFF AND LANDING OF THE DC-8-61 AIRCRAFT
13 Dec. 1966 37 p Revised
(DAC-33379, Rev.) CFSTI: $3.00

Data are presented on the measured noise levels and measured aerodynamic performance necessary to determine noise levels in communities near airports during operation of the aircraft. Because there are very few differences between the −55 and −61 DC-8s, all of the data presented will be applicable to both versions of the aircraft unless indicated. The drag of the DC-8-61 on the approach configuration is significantly less than that of the DC-8-55 as measured during flight. Thus, despite an increase in landing gross weight, the approach noise of the DC-8-61 will be about the same as for the DC-8-55 due to the lower engine thrust required to follow a three degree glide slope. Author

N68-32226# Douglas Aircraft Co., Inc., Long Beach, Calif.
A METHOD FOR THE DETERMINATION OF THE NOISE RADIATED FROM TURBOJET AIRCRAFT DURING TAKEOFF
Michel Kobrynski 23 Nov. 1966 72 p refs Transl. into ENGLISH from ONERA Tech. Note No. 81, 1965
(DAC-33481) CFSTI: HC $3.00/MF $0.65

A general calculation method is proposed which is applicable to airplanes on a test stand, during the takeoff roll and in subsonic flight. The calculation method rests on Lighthill's law of the variation of the acoustic power with SV_j^8 and involves the amplification of the sound intensity through the convection factor (for either stationary or moving jets) and a reduction factor given by an aerodynamic effect and the Doppler attenuation effect. An important result is the evidence of an aerodynamic effect on the turbulence of the jet, a function of $(1 + V_e/V_j)^2$ which causes a change to the emitted frequencies and a reduction of the sound intensity by the factor $(1 + M \cos \Theta_M)^4$. Author

N68-32227# Douglas Aircraft Co., Inc., Long Beach, Calif. Aircraft Div.
METHOD OF CALCULATING NOISE PRODUCED BY JET AIRPLANES DURING TAKEOFF
Michel Kobrynski 6 Sep. 1966 26 p refs Transl. into ENGLISH from ONERA Tech. Paper No. 249 (France), 1965 and La Rech. Aerospatiale (France), No. 105, Mar./Apr. 1965
(DAC-33359) CFSTI: HC $3.00/MF $0.65

A calculation method based on the sound emission laws for stationary and flying jets and on the directional characteristics of the noise has been established. Relations between the noise levels and the characteristics of the jet are defined and verified by a large number of experimental data. This work leads to a unique calculation method for airplanes in flight and on the ground. The application of the method is simplified with the use of design charts. The method is applicable for future airplanes, now in the design stage, whose engines have predicted jet exhaust velocities exceeding those of present-day engines. The investigation of a generalized spectrum, common to all cases, clearly shows the effect of entrainment by the jet in flight on the emitted frequencies. Author

N68-32228# Douglas Aircraft Co., Inc., Long Beach, Calif. Acoustics Section
FLYOVER NOISE DURING TAKE-OFF AND LANDING OF THE SERIES 50 DC-8 WITH P and WA JT3D-1 TURBOFAN ENGINES
A. L. Mc Pike and A. H. Marsh 20 Jul. 1961 34 p refs
(LB-30637) CFSTI: $3.00

The jet exhaust noise of the JT3D-1 engine is considerably lower than that of an equivalent turbojet engine; however, the pure tone whine of the JT3D-1 is greater in magnitude than that of the turbojet and has different directional characteristics. A series of tests were conducted to determine the noise levels under the flight path during takeoff and landing operations of the DC-8 powered by JT3D-1 engines without the Pratt and Whitney Hush Kits. The noise levels as determined by these tests are presented to show what noise levels can be expected in airport communities during takeoff and landing operations. Author

N68-32229# Douglas Aircraft Co., Inc., Long Beach, Calif. Aircraft Div.
FLY-OVER NOISE DURING TAKE OFF OF THE DC-8 WITH JT3C-6 ENGINES
A. L. Mc Pike 22 Mar. 1961 70 p refs Revised
(SM-23641, Rev.) CFSTI: HC $3.00/MF $0.65

A series of tests were run to determine the noise levels under the flight path of the DC-8 during takeoff. The purpose was to show the perceived noise level which can be expected from the DC-8 under various operating conditions during takeoff and to explain how acceptable noise levels can be achieved by the selection of suitable runways and the use of engine power reductions. The data presented show that runways with adequate distance from start of takeoff roll to heavily populated areas must be used and appropriate engine power reductions during takeoff must be considered in relation to airplane loading if the 112 PNdB requirement of the Port of New York Authority is to be satisfied by the DC-8. Author

N68-32230# Douglas Aircraft Co., Inc., Long Beach, Calif. Aircraft Div.
FLY-OVER NOISE DURING TAKE OFF OF THE DC-8 WITH JT4A-9 ENGINES
A. L. Mc Pike 17 Dec. 1959 29 p refs
(SM-23787) CFSTI: $3.00

A series of tests was conducted to determine the noise levels during takeoff under the flight path of the DC-8 with JT4A-9 engines and Daisy-Ejector suppressors. The purpose was to show the perceived noise level which can be expected from the DC-8 under various operating conditions during takeoff, and to explain how acceptable noise levels can be achieved by the selection of suitable runways and the use of engine power reductions. The data presented show that runways with adequate distance from start of takeoff roll to heavily populated areas must be used and appropriate engine power reductions during takeoff must be considered in relation to airplane loading if the 112 PNdB requirement of the Port of New York Authority is to be satisfied by the DC-8. Author

N68-32231# Douglas Aircraft Co., Inc., Long Beach, Calif. Aircraft Div.
SIMILARITY CONSIDERATIONS OF NOISE PRODUCTION FROM TURBULENT JETS, BOTH STATIC AND MOVING
Alan Powell 1 Jul. 1958 23 p refs Previously N63-84105
(SM-23246) CFSTI: $3.00

Once a suitable fundamental equation is chosen, similarity arguments may be applied to the question of noise source distribution in turbulent jets in regions adjacent to the potential cone and far downstream. Certain modifications to the analysis are made in the light of certain experimental data. Similarity analyses then yield the following conclusions. The intensity of source distribution along the jet seems to be nearly constant, perhaps rising slightly, from the exit to some point just beyond the end of the potential cone, after which it falls off rapidly. The high frequency part of the spectrum, arising from regions adjacent to the potential cone, depends on the jet exit velocity raised to the ninth power, or a little greater, and upon 1-2, or somewhat steeper. The assumption that the downstream region of the jet is responsible for the low frequency part of the spectrum results in a spectrum level depending on about the fifth power of the exit velocity with a slope of 1. These results are in moderate agreement with such experimental data as are available. Author

N68-32232# Douglas Aircraft Co., Inc., Long Beach, Calif. Aircraft Div.
GENERALIZED PERFORMANCE OF CYLINDRICAL AND CONICAL AIRCRAFT EJECTORS
R. W. Mc Jones, J. A. Sain, and J. R. Flores 28 Dec. 1956 42 p refs
(LB-25320) CFSTI: $3.00

The available NACA theoretical and experimental studies of cylindrical and conical ejectors have been generalized and combined into working charts for use in estimating the pumping and thrust characteristics of a wide range of aircraft jet-exhaust ejectors. In general, theoretical treatments are limited to ejectors with cylindrical shrouds; however, both cylindrical and conical ejector performance may be correlated against the parameters suggested by cylindrical theory, and the minor variations in performance may be handled by empirical corrections. The most important difference between cylindrical and conical ejectors is a serious thrust loss of the latter type under certain conditions. Author

N68-32233# Douglas Aircraft Co., Inc., Santa Monica, Calif.
THE PUMPING CHARACTERISTICS OF LONG MIXING SECTION JET PUMPS
N. L. Fox 5 Sep. 1952 43 p refs Revised
(SM-14385, Rev.) CFSTI: $3.00

Two theoretical analyses are presented for the pumping characteristics of a jet pump, both of which assume complete mixing in a constant area mixing section which is not choked, and neglected friction. The first analysis, which neglects compressibility, yields an equation sufficiently simple for engineering use. The second analysis, which considers compressibility, leads to a better understanding of the system, but is tedious for calculation. Correction factors, based on experimental data and supported by the compressible analysis, are applied to the incompressible analysis to yield results sufficiently accurate for most engineering use. Author

03 AUXILIARY SYSTEMS

Includes fuel cells, energy conversion cells, and solar cells; auxiliary gas turbines; hydraulic, pneumatic and electrical systems; actuators; and inverters. For related information see also: 09 Electronic Equipment; 22 Nuclear Engineering; and 28 Propulsion Systems.

N68-32403 British Hydromechanics Research Association, Cranfield (England).
THE PREDICTION AND IMPROVEMENT OF REGENERATIVE TURBO-MACHINE PERFORMANCE
J. D. Burton (Simplite Eng.) 1967 23 p refs Presented at the 9th Members Conf., Cranfield, Sep. 1967
(SP-915)

Although persistent research and development effort has been applied to the regenerative pump, these investigations have been pursued with little reference to the application of similar units for turbine operation. This paper is concerned with a theoretical and experimental analysis of both modes of operation; from the power producing turbine condition, through to the power absorbing pump condition. After examining the basic performance laws for regenerative turbomachines, the flow characteristics within the machine are then outlined, enabling a theoretical model to be established taking account of the experimentally observed phenomena. An analysis based on the hypothesis leads to expressions for turbomachine performance over the entire operating range in terms of empirical constants. The derived expressions are compared with previous reported work, before they are extended to predict the improved hydraulic performance achieved by rotor blade shaping. After presenting experimental corraboration of the results obtained, a brief review is undertaken of the ways in which the performance of this type of turbomachine might be further improved, thereby increasing the scope for the future application. Author

N68-32408*# Utah Univ., Salt Lake City. Fluid Control Systems Lab.
OPTIMIZATION OF HYDRAULIC COMPOUND VORTEX AMPLIFIERS Final Report
F. R. Goldschmied 30 Jul. 1968 19 p refs
(Grant NGR-45-003-041)
(NASA-CR-96226) CFSTI: HC $3.00/MF $0.65 CSCL 13G

Research activity on the problem of strong pressure fluctuations in the output of the fluidic amplifier is reviewed. Two specific problems were investigated and are summarized. They are (1) pulsating viscous incompressible flow in a long rigid tube in the intermediate damping range, and (2) oscillating viscous compressible flow in rigid tubes with volume termination. A report bibliography is included. The high pressure hydraulic test facility of a fluid control system laboratory is described with the aid of a layout diagram. D.H.B.

N68-32455*# Franklin Inst., Philadelphia, Pa. Research Labs
RF EVALUATION OF THE SINGLE BRIDGEWIRE APOLLO STANDARD INITIATOR Final Report
Paul F. Mohrbach and Raymond R. Raksnis Aug. 1967 50 p ref
(Contract NAS9-3787)
(NASA-CR-96232; F-B2303-9) CFSTI: HC $3.00/MF $0.65 CSCL 19A

One Hundred and eighty-five Single Bridgewire Apollo Standard Initiators were subjected to RF energy in the frequency interval of from 10 to 9000 MHz (CW and Pulsed) in both the pin-to-pin and pins-to-case modes. The data show that at 9000 MHz, with pulsed power, about 100 milliwatts could fire 50% of the EEDs in either mode. Compared to the 4 pin model (SOI-266-8) which was tested during May of 1965 (FIRL Report F-B2303-1) the single bridge EED is more sensitive at 9000 MHz, pulsed, by a factor of approximately 2.5 to 1. The SOI-266-8 is most sensitive in the bridgewire-to-bridgewire mode but initiations occur by a high voltage "arc" through the explosive charge in all three modes, i.e. pins-to-case, bridge-to-bridge or thru a bridge. No significant effect on such parameters as insulation resistance and pins-to-case capacitance was detected after exposure to RF, if the SBASI was a non-fire. However, 15 of 88 fired devices showed very low final pins-to-case insulation resistance. Author

N68-32549 National Lending Library for Science and Technology, Boston Spa (England).
THE CAUSES OF REDUCED CAPACITY OF THE ZINC ELECTRODE IN ZINC ALKALINE BATTERIES
V. N. Flerov 6 Jun. 1968 18 p refs Transl. into ENGLISH from Zh. Prikl. Khim. (Moscow), v. 33, no. 1, Jan. 1960 p 140–146
In RUSSIAN and ENGLISH
Available from Natl. Lending Library, Boston Spa, Engl.

A study was made of the coefficient of utilization of the active mass in the powder zinc electrode as a function of the number of cycles of operation, service time, presence of additions, charging conditions and some other factors. It has been established that the coefficient of utilization of zinc decreases both during the cycling of the battery and during its idle storage. The characteristics of the zinc electrode remain more stable when the battery is stored in a charged condition (and is regularly re-charged). High temperature during prolonged storage is more harmful to the charged electrode. The capacity of the zinc electrode becomes stabilized when charging is performed at low current densities. A beneficial influence on the

zinc electrode is exerted by a LiOH addition. Electrolyte carbonization and the presence of mercury, tin and silicates decrease the capacity of the zinc electrode. Author

N68-32561*# General Electric Co., Philadelphia, Pa. Missile and Space Div.

FEASIBILITY STUDY 30 WATTS PER POUND ROLL-UP SOLAR ARRAY Final Report

N. F. Shepard, F. A. Blake, W. S. Busch, A. Latour, R. J. Kyle et al 21 Jun. 1968 258 p refs Prepared for JPL

(Contracts NAS7-100; JPL-951970)

(NASA-CR-96230; Rept.-68SD4301) CFSTI: HC $3.00/MF $0.65 CSCL 10A

This report summarizes the preliminary design and analysis of a 250-square-foot roll-up solar array which has a power-to-weight ratio of 32.3 watts per pound. The selected array configuration is presented, along with a complete description of each component within the system. Tradeoff studies and performance analyses are presented, including dynamics, structural, electrical, and weight studies. An engineering demonstration model was designed and fabricated to demonstrate the deployability of the selected flight array. Summaries of related supporting studies and activities cover thermal cycling tests, lubrication, materials, and preliminary design of ground support equipment. K.W.

N68-32595# Boeing Co., Renton, Wash. Commercial Airplane Div.

THE ANALYSIS OF FOUR TYPES OF FLUIDIC ACTIVE INTEGRATION CIRCUITS

Kenneth L. Waters 21 Jun. 1968 68 p refs

(D6-58372-TN; AD-671576)

Linear system analysis techniques were used to analyze several proposed integration circuits. This approach involved use of the approximate fluidic-electrical analogy between circuit components as well as several simplifying assumptions. Among these were resistance linearity and the use of active element static parameters to define element dynamic operation. After each circuit was analyzed by the above techniques, a close examination was made of all factors affecting integration error. Methods were then found to minimize this error. Results indicate that while all four integration circuits are theoretically feasible, integration error contributions and fabrication difficulties favor the use of just two types of integration circuits. The first of these yields integral control only and involves the use of two load-insensitive proportional amplifiers as the active components. The second is a circuit which results in proportional-plus-integral control when used in a feedback control system. Both of these circuits can incorporate commercially manufactured fluidic components in their design and are directly applicable to fluidic feedback control systems. Further, the two circuits involve jet-deflection amplifiers whose static characteristics are not true constants, but instead are dependent on various element pressures. Therefore, both circuits must be adjusted to yield minimum integration error for each application. Author (TAB)

N68-32603*# Atlas Chemical Industries, Inc., Valley Forge, Pa. Aerospace Components Div.

DESIGN AND FABRICATION OF FOUR PIN HIGH PRESSURE SQUIB

J. A. Barrett 8 Jul. 1968 43 p Prepared for JPL

(Contracts NAS7-100; JPL-951912)

(NASA-CR-96285; QR-3) CFSTI: HC $3.00/MF $0.65 CSCL 19A

This report covers work performed in developing, providing design and production drawings for, and manufacturing an initial developmental production quantity of squibs to withstand the extremes of thermal shock and other rigid environmental requirements of deep space probe vehicles. The squib must be capable of withstanding heat sterilization of 293°F for 324 hours. It must be capable of functioning at any temperature from −200°F to +300°F, and must be suitable for exposures of up to one year at any temperature from −400°F to +250°F. In addition, the squib must withstand pressures of up to 30,000 psi without seal failure and must be capable of functioning normally after repeated discharges of 25 kv from a 500 picofarad capacitor. The squib will be a 1 amp, 1 watt no-fire, dual circuit squib, whose output and initiation characteristics will be as uniform as is possible within current limitations. Author

N68-32748# Westinghouse Electric Corp., Lima, Ohio. Aerospace Electrical Div.

DESIGN STUDY OF ELECTRICAL COMPONENT TECHNOLOGY FOR 0.25 TO 10.0 MEGAWATT SPACE POWER SYSTEMS. POWER CONDITIONING: PARAMETRIC SCREENING STUDY

E. F. Swiderski and John W. Gyurek 15 Sep. 1967 411 p refs

(Contract AT(04-3)-679)

(WAED67.45E; SAN-679-4) CFSTI: HC $3.00/MF $0.65

Results of the parametric studies to determine minimum system weight as a function of electrical component rating, voltage and frequency are presented on power conditioning and power distribution equipment for 0.25 to 10.0 MW space nuclear electric power plants utilizing the Rankine conversion cycle. The power conditioning and distribution equipment includes frequency changers, transformers, rectifiers, and transmission lines. The complete results on the parametric studies for the above equipment are presented. Author (NSA)

N68-32768 National Lending Library for Science and Technology, Boston Spa (England).

EXPERIMENTAL INVESTIGATION OF SELF-EXCITATION OF THE INDUCTOR GENERATOR [EKSPERIMENTAL'NOE ISSLEDOVANIE SAMOVOZBUZHDENIYA INDUKTORNOGO GENERATORA]

S. K. Bokhyan Apr. 1968 10 p refs Transl. into ENGLISH from Elektrotekhnika (Moscow), no. 2, Feb. 1967 p 6–8

(RTS-4439) Available from Natl. Lending Library, Boston Spa, Engl.: 7s 6d

Experimental results are given on an investigation of self-excitation of the inductor generator with a capacitive excitation. Conditions for origination, development, and establishment of self-excitation are analyzed. Author

N68-32919*# Radio Corp. of America, Princeton, N. J. Astro Electronics Div.

ACTION OF LITHIUM IN RADIATION HARDENED SILICON SOLAR CELLS Quarterly Report, 23 Apr.–15 Jul. 1968

G. J. Brucker, T. J. Faith, and A. G. Holmes-Siedle 15 Aug. 1968 47 p refs Prepared for JPL

(Contracts NAS7-100; JPL-952249)

(NASA-CR-96277; QR-1) CFSTI: HC $3.00/MF $0.65 CSCL 10A

This is a report on a program to study and analyze the action of lithium in producing a recovery of radiation damage in silicon solar cells. Technical progress during this reporting period includes stability data which are now available for some cells for periods ranging to approximately two years. The post-irradiation data, obtained after fluences of 10^{14}, 10^{15}, and 10^{16} e/cm^2, indicates that post-recovery redegradation is most severe after 10^{14} e/cm^2. After 10^{15} and 10^{16} e/cm^2, recovery is less complete but redegradation less severe. Over an 18-month period, redegradation phenomena in lithium-containing solar cells can vary from insignificant in magnitude to very serious. A definite superiority of Float-Zone-refined silicon over Lopex silicon is seen; the few

samples tested indicate that Quartz-Crucible silicon, while producing a much slower recovery than the other two, shows minimal redegradation over 18 months. High lithium concentrations are definitely to be avoided. It appears that lattice damage is present in the junction depletion region even before irradiation and that this can be useful in stabilizing lithium in the cell. Hall and resistivity measurements indicate that carrier-removal rates at low temperatures are lower in lithium-doped silicon than in phosphorus-doped silicon, which also contains oxygen. Author

N68-33062*# AiResearch Mfg. Co., Los Angeles, Calif.
RECUPERATOR FOR SOLAR BRAYTON CYCLE SYSTEM
A. F. Anderson Washington NASA Aug. 1968 222 p refs
(Contract NAS3-2793)
(NASA-CR-1150) CFSTI: HC $3.00/MF $0.65 CSCL 10B

Results are presented of analytical and test work conducted on a recuperator to be utilized in a closed Brayton cycle space power system that uses solar energy as a heat source and argon as the working fluid. The initial phase of the work was a parametric design study to determine the optimum recuperator operating conditions for the Brayton cycle. The study was followed by analysis and testing for the final design configuration. The final phase of this program included fabrication and testing of a recuperator. Author

N68-33103# Massachusetts Inst. of Tech., Cambridge. Center for Space Research.
BOUNDARY AND END LOSSES IN MAGNETOGASDYNAMIC GENERATORS Final Report, 1 Feb. 1967–30 Apr. 1968
Myron A. Hoffman, Michael Hsu, Gordon C. Oates, and James P. Reilly Jun. 1968 47 p refs
(Contract DAHC 04-67-C-0026)
(CSR-TR-68-8; AROD-6346.2-E; AD-671632)

One of the major potential loss mechanisms for magnetogasdynamic generators operating at high Hall parameters is that of eddy currents in the entrance and exit regions of the generator. An experiment was designed to test the concept of fluid injection as a means of suppressing the exit current loops. Theoretical studies indicate that if sufficiently small droplets on the order of 5 to 30 microns in diameter are introduced into the plasma flow, they would be very effective in quenching the electrical conductivity of the exit region through the mechanism of electron and ion capture. An experiment on a subsonic MGD channel employing axial injection of fine water jets did not result in a rise in open circuit voltage which could be positively attributed to the water injection. It is tentatively concluded that the water jets did not break up into sufficiently small droplets to quench the electrical conductivity in the exit region. Author (TAB)

N68-33112*# Utah Univ., Salt Lake City.
PRELIMINARY DEVELOPMENT OF COMPOUND VORTEX AMPLIFIERS FOR HYDRAULIC HIGH-PRESSURE APPLICATION
Fabio R. Goldschmied Jul. 1968 30 p refs
(Grant NGR-45-003-041)
(NASA-CR-96234; UTEC-ME-68-047) CFSTI: HC $3.00/MF $0.65 CSCL 13G

The present paper is concerned with the fluidic control of high hydraulic pressures at the 700 to 2000 N/cm^2 (1000 to 3000 psi) level by means of the hydrodynamic vortex phenomenon. Vortex devices may be classified as control valves if they offer a variable flow resistance in a pipeline, regardless of the control input requirements, of they may be classified as amplifiers if the control input is much smaller that the net output in terms of pressure and flow. Hydraulic vortex devices are described, for high-pressure hydraulic application; in all cases the control pressure is higher than the supply pressure throughout the flow turndown range. This fact has been found also in numerous low-pressure model investigations by academic researchers. Author

N68-33186*# National Aeronautics and Space Administration. Flight Research Center, Edwards, Calif.
AERONAUTICAL FLIGHT-CONTROL SYSTEMS RESEARCH
Jack Fischel and Shu W. Gee *In its* Aerospace Electron. Systems Technol. 1967 p 245–259 (See N68-33169 20-30)

Approximate flight envelopes of operational aircraft are compared with the projected envelopes of future advanced aircraft, and flight control system development is reviewed. The problems inherent in the electrical-mechanical-hydraulic flight control systems are delineated with particular reference to the X-15 aircraft; the effect of the electronic stability augmentation systems (SAS) is also considered. It is pointed out that the increasing complexity of flight control systems resulting from the increased performance of future aircraft can be best resolved electrically, by a fly-by-wire system. In the 1967 version, the mechanical linkages were omitted or disconnected and electrical signals from the pilot's control are used (directly or through an electronic computer) to control hydraulic actuators which drive the control surfaces. The use of the system on NASA variable stability aircraft is discussed. Advanced display concepts are proposed. Emphasis is placed on the need for the electronics industry to provide completely reliable, low cost, easily maintained systems for the more exacting flight control of future aircraft. M.G.J.

N68-33207*# General Electric Co., Philadelphia, Pa. Missile and Space Div.
CADMIUM SULFIDE THIN FILM SOLAR CELL ARRAY SUB-PANEL DEVELOPMENT Final Report
F. A. Blake 15 Aug. 1968 28 p
(Contract NAS3-11821)
(NASA-CR-72439; DIN-68SD4299) CFSTI: $3.00 CSCL 10A

Advancement of the art of cadmium sulfide solar array technology from the module to sub-panel (100 cells) stage was accomplished. Twelve modules of 25 cells each were fabricated using both of the previously developed interconnection methods. These were tested and assembled into three sub-pannel units of four modules each. Procedures for sub-panel manufacture together with weight and performance data defining the present state of the CdS solar array technology are presented. Author

N68-33270*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
THERMAL DESIGN PROCEDURES FOR SPACE RANKINE CYCLE SYSTEM BOILERS
J. R. Peterson (GE, Evendale, Ohio), R. N. Weltmann, and M. U. Gutstein Aug. 1968 16 p refs Presented at the IEEE Intersoc. Energy Conversion Eng. Conf., Boulder, Colo., 13–16 Aug. 1968
(Contract NAS3-2528; NAS3-9426)
(NASA-TM-X-61162; GESP-67) CFSTI: HC $3.00/MF $0.65 CSCL 13A

A boiler design procedure based upon correlations of experimental data is presented and employed to design a once-through counterflow potassium boiler for an advanced Rankine cycle space power system. The procedure considers nonuniform axial distribution of heat flux and four distinct heat transfer regions; namely, the superheat, transition, nucleate and subcooled regions. The effects of several variables upon boiler tube length are shown and optimization procedures discussed. The design procedure is shown to predict the length of a single tube once-through mercury boiler with about 15%. Author

N68-33336*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
RADIATION PROPERTIES OF A CDS SOLAR CELL AND VARIOUS METALS AT SPACE CONDITIONS
John R. Jack and Ernie W. Spisz Washington 1968 12 p refs Presented at the 3d Space Simulation Conf. Sponsored by Inst. of Environ. Sci., AIAA, and the ASTM, Seattle, 16–18 Sep. 1968
(NASA-TM-X-52457) CFSTI: HC$3.00/MF$0.65 CSCL 10A

Simulated space environmental tests conducted on five prospective spacecraft metals and a state-of-the-art thin film cadmium sulfide solar cell indicated that, from 230 to 520°K, the hemispherical emittance of the metals increased with increasing temperature. Solar absorptance was approximately constant and the absorptance-emittance ratio for the metals decreased with increasing temperature. This ratio for the CdS solar cell was approximately constant (0.43) at temperatures from 200 to 325°K, although below 200°K the ratio increased rapidly to a value of 0.70 at 150°K. Emittance decrease with decreasing temperature is considered to be the cause of this rapid drop. The apparatus and procedure employed in determining radiation properties are described; and the optical properties for both the metals and the solar cell are discussed and presented graphically. M.W.R.

N68-33384*# Honeywell, Inc., Montgomeryville, Pa. Livingston Electronic Lab.
LOW TEMPERATURE BATTERY Final Report, 14 Dec. 1965–13 Dec. 1967
George M. Armstrong and Jon. S. Gore 13 Dec. 1967 178 p ref
(Contract NAS3-8503)
(NASA-CR-96448) CFSTI: HC$3.00/MF$0.65 CSCL 10C

A low temperature, electrochemical, ammonia cell in hardware, excluding activator, has been developed with the capability of delivering 1.5 watts for six minutes and 0.3 watts for fifty-four minutes each hour, alternating continuously for a minimum of seventy-two hours to an end voltage of 1.5 at −73°C. The system employed was $Mg/KSCH\text{-}NH_3/HgSO_4$:S. Representative groups of cells met the requirement after inactive stand at temperatures of +20 to 25°, −20°, and +65°C for periods up to six months. The environmental test requirements for vibration, acceleration, shock, and acoustic noise were met by all of fourteen cells selected at random. The best results obtained in hardware were as follows: 148 hours at +20°, 44 hours at −20°, 58 hours at −40°, 90 hours at −73°, and 88 hours at −90°C to a 1.5 volt cut-off under heavy load. Author

N68-33464* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
COMPARISON BETWEEN VAPOR CHAMBER AND CONDUCTING FIN BRAYTON RADIATORS
John W. Larson (GE, Philadelphia) and James P. Couch [1968] 11 p refs Presented at the IEEE Intersoc. Energy Conversion Eng., Boulder, Colo., 13–16 Aug. 1968
(Contract NAS3-10615)
NASA-TM-X-61163) CFSTI: $3.00 CSCL 13A

Preliminary designs of both vapor chamber and conduction fin radiators were generated for a Brayton cycle space powerplant. Heat rejected by this radiator was about 15 KW. The designs are comparable in both size and weight for this Brayton application. Suitable working fluids for aluminum vapor chambers operating at 0° to 350°F include ammonia, benzene, pentane, and water. Author

N68-33502*# Radio Corp. of America, Princeton, N. J. Astro-Electronics Div.
RADIATION DAMAGE IN LITHIUM-CONTAINING SOLAR CELLS Final Report, 21 Jun. 1966–20 Mar. 1968
G. Brucker, T. Faith, A. G. Holmes-Siedle, and R. Neadle Apr. 1968 111 p refs
(Contract NAS5-10239)
(NASA-CR-96368) CFSTI: HC$3.00/MF$0.65 CSCL 10A

The interactions of lithium with defects induced in silicon solar cells by 1-MeV electron bombardment have been investigated. Solar cells used as test vehicles were supplied by NASA and test diodes similar to solar cells were made. The principal techniques used in the study to investigate the interaction of lithium with a radiation induced damage center were (1) the capacitance method of measuring donor (lithium) concentration, (2) the electron-voltaic method of measuring diffusion length, and (3) the measurement of diffusion length vs. excess carrier density. Recovery of solar cells appeared to follow a diffusion-limited kinetic model. Recovery theory was shown to correlate with measurements of lithium density profiles and direct measurements of the effective lithium-diffusion constant. The electric field arising from the ratio of donor-concentration gradient to donor concentration is, in some cases, sufficiently large to affect the collection of minority carriers. The effect of the electric field is particularly important when the diffusion length is reduced to a low value by electron bombardment; at that point the concept of a diffusion length begins to lose its physical meaning. Author

04 BIOSCIENCES

Includes aerospace medicine, exobiology, radiation effects on biological systems; physiological and psychological factors. For related information see also: 05 Biotechnology.

N68-32424*# Naval School of Aviation Medicine, Pensacola, Fla.
SCREENING OF SQUIRREL MONKEYS (SAIMIRI SCIUREUS) FOR VESTIBULAR FUNCTION STUDIES
Makoto Igarashi, Ashton Graybiel, and F. Robert Deane 9 May 1968 14 p refs
(NASA Order R-93)
(NASA-CR-96199; NAMI-1042) CFSTI: HC $3.00/MF $0.65 CSCL 06C

The study was undertaken to learn the incidence of unrecognized otological disease in young, healthy squirrel monkeys (*Saimiri sciureus*) maintained under optimum laboratory conditions. No definite pathological changes were found in the middle ears of 20 out of 22 ears examined. Morphologically, all inner ear end organs appeared normal. All threshold caloric test values were within the normal range. No significant variance was noted among the trials. Six out of eleven squirrel monkeys were not susceptible to motion sickness on repeated trials in the slow rotation room. Thus, the lack of susceptibility to motion sickness does not necessarily reflect pathologic suppression of semicircular canal function. Author

N68-32427*# Alabama Agricultural and Mechanical Coll., Normal.
RADIATION EFFECTS ON THE METABOLISM OF PHOSPHOLIPIDS IN THE CENTRAL NERVOUS SYSTEM OF ALBINO RATS: EFFECTS OF X-RAYS ON SPHINGOMYELIN BIOSYNTHESIS IN BRAIN AND SPINE MITOCHONDRIA OF ALBINO RATS Progress Report, 1 Jul. 1967–31 Aug. 1968
Charlotte O. Lee Aug. 1968 43 p refs
(Grant NGR-01-001-003)
(NASA-CR-96228; PR-5) CFSTI: HC$3.00/MF$0.65 CSCL 06R

The effect of x-rays on the biosynthesis of the phospholipid, sphingomyelin, in brain and spinal cord mitochondria has been studied. Mitochondria were isolated from male rats, irradiated and incubated with precursors of sphingomyelin. Sphingomyelin was isolated from the reaction mixture as alkali stable phospholipid.

identification of sphingomyelin was accomplished by infrared spectra, thin layer chromatography, and phosphorus determinations. Spinal cord mitochondria appeared to be the best source of ceramide transferase for sphingomyelin synthesis. X-irradiation caused an increase in sphingomyelin from both spinal cord and brain mitochondria. Moderate doses of x-rays caused a destruction of the carbonyl function of myristaldehyde. Author

N68-32429 National Lending Library for Science and Technology, Boston Spa (England).
DARK AND PHOTOCHEMICAL REACTIONS OF HYDROGENATION AND DEHYDROGENATION OF COMPOUNDS OF THE PORPHIN SERIES [TEMNOVYE I FOTOKHIMICHESKIE REAKTSII GIDRIROVANIYA DEGIDRIROVANIYA SOEDINENII RYADA PORFINA]
A. N. Sidorov Feb. 1968 25 p refs Transl. into ENGLISH from Akad. Nauk SSSR (USSR), 1966 p 267–282
(RTS-4318) Available from Natl. Lending Library, Boston Spa, Engl.: 40s

The biogenesis of chlorophyll and its analogues by photosynthesising organisms and the part played by pigments in the process of photosynthesis cannot be understood without a detailed study of the chemical and photochemical properties both of chlorophyll itself and of the whole class of compounds to which chlorophyll belongs–the porphin class. Studies of these properties are a necessary stage on the way toward the control of processes of natural photosynthesis and the evolving of artificial photosynthesising models. This paper examines the reactions of hydrogenation and dehydrogenation of molecules of compounds of the porphin series. These include the hydrogenation of one or two pyrrole rings, which leads to the formation of the corresponding chlorins or bacteriochlorins. A particular case of such reactions is the conversion of protochlorophyll to chlorophyll. Author

N68-32510 National Lending Library for Science and Technology, Boston Spa (England).
THE MODELLING OF CERTAIN PROCESSES OF PHYSIOLOGICAL ADAPTION OF AN ELECTRONIC COMPUTER
S. N. Braines and V. B. Svechinski Apr. 1968 17 p refs Transl. into ENGLISH from Eksperim. Khirur i Anesteziol. (Moscow), v. 9, no. 5, 1964 p 9–17
(RTS-4419) Available from Natl. Lending Library, Boston Spa, Engl.: 20s

Algorithms for optimal regimes of physiological adaptation processes are developed by optimizing the human homeostatic system. Mechanisms of the lines of action in the nervous system are classified and their algorithms and structures obtained by analyses of the biological structures and the links between them. An algorithm of seeking the optimal regime on a computer is formulated by a program that consists of the following three parts: (1) determination of control action; (2) calculation of the results of the action; and (3) maintenance and change of the value of the information-associated elements. G.G.

N68-32581 National Lending Library for Science and Technology, Boston Spa (England).
ELEMENTS OF A GENERAL THEORY OF CONTROL IN THE BODY [ELEMENTY OBSHCHEY TEORII UPRAVLENIYA V ORGANISME]
S. N. Braines and V. B. Svechinsky Mar. 1968 7 p refs Transl. into ENGLISH from Eksperim. Khirur. i Anesteziol. (Moscow), v. 8, no. 5, 1963 p 3–8
(RTS-4420) Available from Natl. Lending Library, Boston Spa, Engl.: 15s

Closed processes of control, referred to as local processes, were investigated in relation to the autoregulation in complicated biological systems. The general structure for the control of physiological processes in the living organism is considered to be a system with three interconnected levels. The local systems are at the lowest levels, the second level controls the system of homeostasis for the general condition of the internal environment of the body, and the highest level changes the activities of the control level because of external environmental conditions. Various schematics are presented to show the interrelationships between these three levels, and the effects of autoregulation by cells and intracellular mechanisms is emphasized in the overall control process of the body. This general discussion considers a hypertensive disease to indicate malfunction of body controls. M.W.R.

N68-32582 National Lending Library for Science and Technology, Boston Spa (England).
ORGANISING ACTIVITY IN TIME PERCEPTION [VOSPRIIATIE VREMENI I USTANOVKA]
K. D. Mdivani Feb. 1968 14 p refs Transl. into ENGLISH from Psikhologicheskie Issled. in A.S. Prangishvili Tbilisi (USSR), 1966 p 114–121
(RTS-4099) Available from Natl. Lending Library, Boston Spa, Engl.: 20s

Human reactions were compared for two durations of light signals presented by an automatically timed electrotachistoscope in order to study any organizing activity in time perception. Ninety-nine psychologists and students were asked to compare the duration of 8 sec and 2 sec flashes on the tachistoscope screen; and, after 10 or 15 such trials, the subjects were asked to compare two flashes of equal (5 sec) duration. A strong illusion of contrast was exhibited by 44 subjects, a weak illusion by 27, an assimilative illusion by 17, and no illusion by 11. Each act of perception is considered the result of the mechanism representing a complete interdependence of the experience of the subject and the actual data; and the reaction to the outside stimulus is evaluated and reassessed by the subject according to his experience. M.W.R.

N68-32669 Lovelace Foundation for Medical Education and Research, Albuquerque, N. Mex.
THE RELATION BETWEEN EARDRUM FAILURE AND BLAST-INDUCED PRESSURE VARIATIONS
Clayton S. White, I. G. Bowen, and Donald R. Richmond Aug. 1967 64 p refs
(Contract DA-49-146-XZ-372)
(DASA-2064; AD-671618)

In field and laboratory experiments designed to study overall blast effects, incidental observations were made of the ears of over 490 animals. Those inside structures were exposed to a variety of atypical blast waves. Those located inside shock tubes or in the open when high explosives were detonated were exposed to fairly typical wave forms. An attempt was made to relate the incidence of eardrum rupture to various elements of the measured pressure-time curves. The association was not the same for typical and atypical wave forms. Within the limits of the meager differences were noted and discussed with emphasis on the apparent wide variability in tolerance for which an explanation was proposed. Author (TAB)

N68-32684 National Lending Library for Science and Technology, Boston Spa (England).
MODERN IDEAS ON THE STRUCTURE OF CELL MEMBRANES [SOVREMENNOE PREDSTAVLENIE OF STRUKTURE KLETOCHNYKH MEMBRAN]
V. L. Borovyagin Apr. 1968 32 p refs Transl. into ENGLISH from Tsitologiya (Moscow), v. 9, no. 6, 1967 p 805–823
(RTS-4481) Available from Natl. Lending Library, Boston Spa, Engl.: 40s

Presented is a review of current research on the molecular structure of cell membranes. Cited are studies of the chemical composition of biomembranes; the structure of myelin sheaths of

axons; the structure of the outer segments of photoreceptors; lipid and lipoprotein models of membranes; transverse sections of cell membranes using electron microscopic techniques; the dimensions of cell membranes; granular and globular types of organization of cell membrane components; the probability of the existence of a globular type of lipid organization in living cell membranes; and the structure of extra-cellular and cytoplasmic layers of biomembranes. It is concluded that although different cell membranes consist of different chemical components having a different spatial organization from that of the monolayer envisaged in the hypothetical model of molecular organization of biomembranes proposed by Davson and Danielli, the majority of experimental data obtained directly support the common principle of organization stipulated in the Davson–Danielli model, i.e., the biomolecular palisade of lipid molecules linked on both sides by their polar groups with the globularly organized monolayers of non-lipid components. S.C.W.

N68-32695# New Mexico State Univ., University Park.
BEHAVIORAL ANALYSIS OF AUDITORY FUNCTIONING IN PRIMATES Final Report, 1 Feb. 1967–31 Jan. 1968
James N. Allen, Leslie A. Dalton, Jr., Wendon Henton, and Henry L. Taylor May 1968 24 p refs
(Contract F29600-67-C-0029)
(ARL-TR-68-6; AD-671987)

An experiment was performed for the purpose of evaluating the usefulness of the technique of conditioned suppression of auditory threshold determination in rhesus monkeys. Nine rhesus (Macaca mulatta) monkeys were shaped to the lever in an operant conditioning experiment and trained until a stable rate of response on a variable interval 90 schedule was attained. At this point training in conditioned suppression was undertaken. The criterion of suppression used was a 90 percent or better ratio for 3 consecutive days. When criterion was reached, threshold testing was begun and continued until a range of dB levels which surrounded the 50 percent suppression ratio level was reached and maintained more or less stable for 3 days of testing. Stimuli in the region of the threshold were separated by 2 dB increments, and trials at each intensity level were presented several times in a non-systematic fashion. Threshold was defined as the dB level at which the line connecting the suppression ratios to the 2 dB apart stimuli crossed the 50 percent suppression ratio. The technique yields results which are remarkably stable over time and which are achieved with minimum difficulty. No other technique yet devised seems to be superior to conditioned suppression in any particular degree if ease of accomplishment and intra-organismic temporal stability are desired. Author (TAB)

N68-32707*# National Aeronautics and Space Administration, Washington, D. C.
AEROSPACE MEDICINE AND BIOLOGY A Continuing Bibliography with Indexes
Jul. 1968 150 p refs
(NASA-SP-7011(52)) CFSTI: HC$3.00/MF$0.65 CSCL 06S

Subject coverage concentrates on the biological, physiological, psychological, and environmental effects to which man is subjected during and following simulated or actual flight in the earth's atmosphere or in interplanetary space. References describing similar effects on biological organisms of lower order are also included. Such related topics as sanitary problems, pharmacology, toxicology, safety and survival, life support systems, exobiology, and personnel factors receive appropriate attention. Each entry consists of a standard citation accompanied by its abstract. Author

N68-32764 National Lending Library for Science and Technology, Boston Spa (England).
EFFECTS OF VARIATIONS OF DIET ON SECRETORY FUNCTION OF THE SMALL INTESTINE [SEKRETORNAYA FUNKTSIYA TONKOGO KISHECHNIKA PRI RAZLICHNYKH REZHIMAKH PITANIYA]
M. P. Stanets May 1968 5 p Transl. into ENGLISH from the book "Regulyatsiya Vegetativnykh Funktsii" Kiev, Izd. AN Urk. SSR 1965 p 155–158
(RTS-4530) Available from Natl. Lending Library, Boston Spa, Engl.: 10s

An investigation was conducted to study the secretory function of the small intestine in association with four different patterns of food intake. Experiments were performed on young dogs which were subjected to various patterns of eating. The results are discussed in relation to changes in the amount of secretion by the small intestine, the enterokinase and phosphatase content, and changes in the sucrose content. It was concluded that a break in the customary sterotype by transferring the animal from one feeding pattern to any other pattern influences the secretory process in the small intestine. B.S.D.

N68-32800# Systems Research Labs., Inc., San Antonio, Tex.
CARDIOVASCULAR IMPLICATIONS OF SPACE TUMBLING: CONDITIONING, TRAINING, AND PROTECTION
S. T. Lim Brooks AFB, Tex. School of Aerospace Med. Apr. 1968 20 p refs
(Contract AF 41(609)-2897)
(SAM-TR-68-32; AD-671510)

Cardiovascular deconditioning occurs as a result of exposure to zero-gravity. Whereas cardiovascular deconditioning produced by water immersion can be prevented by pressure cuffs, and that produced by bed rest can be prevented by passive exercise, such measures are not effective against deconditioning due to space flight. The author suggests certain experiments to study response to tumbling by the conditioned cardiovascular system and by the deconditioned system. The theoretic pressure input resulting from human centrifugation is graphically represented. Tumbling is considered the short-radius spectrum of centrifugation. The concept of the hydrostatic indifference point is discussed in the light of the marked curvature of the pressure profile when the center of rotation is very near one end of the body and the parabolic form of the pressure curve when the center of rotation is within the body. Author (TAB)

N68-32994# Air Proving Ground Center, Eglin AFB, Fla. Human Factors/Biomedical Div.
HUMAN FACTORS/BIOMEDICAL SAFETY CONSIDERATIONS FOR NEODYMIUM LASERS
Charles V. Durham Jun. 1968 26 p refs
(APGC-TR-68-53; AD-671993)

This guide was developed as an aid to personnel using neodymium laser systems. It contains both a brief discussion of the characteristics of laser systems in general, and a more detailed review of the neodymium, doped laser and associated hazards. Specific recommendations are made in regard to the safe operation of the neodymium laser during ground and airborne operations. Author (TAB)

N68-32995# School of Aerospace Medicine, Brooks AFB, Tex.
TECHNIC AND APPLICATIONS OF FLUORESCENCE ANGIOGRAPHY IN AEROSPACE OPHTHALMOLOGY
William A. Newsom and Thomas J. Tredici Mar. 1968 10 p refs
(SAM-TR-68-21; AD-671532)

Fluorescence angiography is used by personnel in the Ophthalmology Branch, USAF School of Aerospace Medicine, to evaluate ocular problems. It has diagnostic value in evaluating patients with various intraocular pathologies. It can be used to study the progression and pathophysiology of retinal and choroidal

conditions, such as arterial serous retinopathy, intraocular tumors, diabetic retinal changes, etc. The potential uses of this technic as a tool in research extends to other types of stress as they affect retinal circulation. Author (TAB)

N68-33005*# Stanford Research Inst., Menlo Park, Calif.
A PRELIMINARY STUDY OF THE AWAKENING AND STARTLE EFFECTS OF SIMULATED SONIC BOOMS
Jerome S. Lukas and Karl D. Kryter Washington NASA Sep. 1968 74 p refs
(Contract NAS1-6193)
(NASA-CR-1193) CFSTI: HC$3.00/MF$0.65 CSCL 05E

Results of experiments on the startling and awakening effects of sonic booms are presented. The objectives were to: (1) build and test a device and associated room where one could simulate the effects of sonic booms on a room in a house, and (2) conduct studies of the effects of the simulated indoor booms on people sleeping and performing manual tasks. The tentative findings are based on a study of a small, homogeneous group of subjects. Author

N68-33037# Library of Congress, Washington, D. C. Aerospace Technology Div.
SOVIET RADIOBIOLOGY
E. Fortunatow 10 Jun. 1968 94 p refs
(ATD-68-105-108-9; AD-671436)

Contents: 'Space oriented radiobiology; Genetic aspects of radiobiology; Radioprotective measures; Effects of radiation combined with other spaceflight factors; Non space-oriented radiobiology; Biological effects of magnetic, electromagnetic, and electric fields. TAB

N68-33066*# Oregon State Univ., Corvallis.
SYSTEMATIC DESCRIPTION AND KEY TO *STREPTOMYCES* ISOLANTS FROM CHILE, MEXICO AND ARIZONA DESERT SOILS Progress Report
W. S. Bollen and Sumie Nishikawa 19 Aug. 1968 100 p refs Prepared for JPL
(Contracts NAS7-100; JPL-950783)
(NASA-CR-96470) CFSTI: HC$3.00/MF$0.65 CSCL 06M

Thirty-six isolants from Chile, Mexico or Arizona desert soils have been examined. Of these, eighteen have been classified, four are in the process of being identified and will be described in the next report. The remaining fourteen isolants have failed to grow in tryptone–yeast extract broth at 28°, thioglycollate broth at 7, 28, and 37°C, trypticase soy broth at 28°C, upon tryptone–glucose–yeast extract agar at 7, 28, and 37°C, trypticase soy agar at 28°C, soil extract agar at 7, 28, and 37°C, glucose nutrient agar, malt extract agar, starch agar, and sodium albuminate agar at 28°C. Author

N68-33067# Federal Aviation Administration, Oklahoma City, Okla. Physiology Lab.
CONTRIBUTION OF ACTIVITY TO THE CIRCADIAN RHYTHM IN EXCRETION OF MAGNESIUM AND CALCIUM
Vincent Fiorica, Mary Jo Burr, and Russell Moses Mar. 1968 8 p refs
(AM-68-4)

Eight subjects were maintained on a standard dietary regimen ingested every four hours for 120 hours. Measurements of the magnesium and calcium excretion in these subjects revealed a circadian periodicity with maximal levels of excretion for both ions occurring during the sleeping hours (2200–0600) and minimal levels occurring during the mid-day (1000–1400). Further studies on the effects of activity (exercise) on the excretion of magnesium and calcium demonstrated a marked decrease during and following exercise accompanied by no significant change in the plasma concentrations of the two ions. These data suggest that the periodicity in excretion reported here reflects an activity cycle generated by alternate periods of sleeping and waking and may not represent an endogenous rhythm of magnesium and calcium excretion. Author

N68-33128# Aerospace Medical Div. Aerospace Medical Research Labs. (6570th), Wright-Patterson AFB, Ohio.
EFFECT OF SODIUM FLUORIDE AND AMOX (NF3O) ON GROWTH AND THYROID FUNCTION IN THE RAT Final Report, Mar.–May 1967
Ethard W. Van Stee Jan. 1968 17 p refs
(AMRL-TR-67-189; AD-671942)

Intact and thyroidectomized growing rats were treated daily for 60 days with thyroxine, potassium iodide, sodium fluoride, or NF3O, an oxidizing substance. Results indicated that treatment with NaF or NF3O at doses which were molar equivalents with respect to fluoride to a thyrotoxic dose of iodide had no effect on thyroid function measured by growth rate, 131 I-uptake, and adrenal weight. A sparing effect of thyroid on NF3O toxicity was suggested. Autho. (TAB)

N68-33269# Joint Publications Research Service, Washington, D. C.
SPACE PLANT-GROWING
V. P. Dadykin 28 Aug. 1968 62 p refs Transl. into ENGLISH from Kosmich. Rasteniyevodstvo (Moscow), Biol. Ser. no. 1, 1968 p 1–64
(JPRS-46306) CFSTI: HC$3.00/MF$0.65

Possible ways of using terrestrial plants to support life during long space flights are considered. Human physiological processes are discussed in terms of daily dietary requirements, and average intake and output of substances. The factors involved in selecting the species to be used in developing higher autotrophic organisms for closed ecological systems are assessed, and hydroponic and aeroponic methods of plant cultivation are described. The importance of biological compatibility is stressed. M.G.J.

N68-33286# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
EFFECT OF IONIZING RADIATION AND DYNAMIC FACTORS OF THE FUNCTION OF THE CENTRAL NERVOUS SYSTEM; PROBLEMS IN SPACE PHYSIOLOGY (SELECTED ARTICLES)
15 Sep. 1967 28 p Transl. into ENGLISH from the book "Vliyaniye Ioniziruyushchikh Izlucheniy i Dinamicheskikh Faktorov na Funktsii Tsentral'noy Narvnoy Sistemy; Voprosy Kosmicheskoy Fiziologii" Moscow, Izd. Nauka, 1964 p 92–102, 122–127, 162–181
(FTD-MT-24-142-67; AD-670253)

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3. THE EFFECT OF WHOLE-BODY VERTICAL VIBRATION AND X-RAYS ON THE NUCLEUS OF CELLS OF BONE MARROW CELLS OF MAMALS Yu. S. Demin p 13–27 (See N68-33288 20-04)

N68-33286# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

THE COMBINED EFFECTS OF VIBRATION AND ACUTE IRRADIATION ON THE FUNCTIONAL STATE OF THE VESTIBULAR APPARATUS OF GUINEA PIGS [KOMPLEKSNOYE DEYSTVIYE VIBRATSII I OSTROGO OBLUCHENIYA NA FUNKTSIONAL'NOYE SOSTOYANIYE VESTIBULYARNOGO APPARATA MORSKIKH SVINOK]

Z. I. Apanasenko *In its* Effect of Ionizing Radiation and Dyn. Factors of the Function of the Central Nervous System; Probl. in Space Physiol. 15 Sep. 1967 p 1–7 (See N68-33285 20-04)

Guinea pigs were first subjected to 15 min of vibration, then irradiated 20 to 30 min later with 500 r of gamma rays, and finally exposed to a second 15-min period of vibration 23 to 24 hr after irradiation. Peripheral blood, weight, temperature, and general clinical condition and viability of the animals were also monitored. The combined effects of exposure to vibration and gamma irradiation were found to increase the spontaneous electrical activity of the hind leg extensor muscles with the animals in a state of relative rest. Increase in the latent period of the myoelectrical reaction to vestibular stimulation following exposure occurs only shortly before the death of the animal. When animals are exposed to vibration and radiation, vibration always substantially modifies the effects of radiation on the nervous system. On the other hand, as far as composition of the peripheral blood, weight, and the general clinical condition and viability of the animals are concerned, no statistically significant differences between animals exposed to the effects of radiation alone was detected. Author

N68-33287# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

COMBINED EFFECT OF VIBRATION AND IONIZING RADIATION ON THE FUNCTIONAL STATE OF THE SPINAL REFLEX ARC [KOMILEKSNOYE DEYSTVIYE VIBRATSII I IONIZIRUYUSHCHEGO IZLUCHENIYA NA FUNKTSIONAL' NOYE SOSTOYANIYE DUGI SPINNOMOZGOVOGO REFLEKSA]

M. A. Kuznetsova *In its* Effect of Ionizing Radiation and Dyn. Factors of the Function of the Central Nervous System; Probl. in Space Physiol. 15 Sep. 1967 p 9–12 (See N68-33285 20-04)

Guinea pigs were first subjected to 15 min of vibration then irradiated 30 to 40 min later with 500 r of gamma rays, and finally exposed to a second 15-min period of vibration 24 hr after irradiation. The combined effects of vibration and irradiation induced significant changes in the functional state of the defense reflex arc which were manifested as changes in the stimulation threshold and the length of the latent period of the reflex. In a number of cases, parabiotic phenomena appeared in response to stimulation of various magnitudes. Changes in the length of the latent period and the stimulation threshold were independent of each other. The combined effects of irradiation and vibration induced a complex reaction which was sometimes dominated by vibration effects and sometimes by irradiation effects, while in other cases a summation of the effects of the two factors was observed. Author

N68-33288# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

THE EFFECT OF WHOLE-BODY VERTICAL VIBRATION AND X-RAYS ON THE NUCLEUS OF CELLS OF BONE MARROW CELLS OF MAMMALS [DEYSTVIYE OBSHCHEY VERTIKAL'NOY VIBRATSII I RENTGENOVYKH LUCHEY NA YADRO KLETOK KOSTNOGO MOZGA MLEKOPITAYUSHCHIKH]

Yu. S. Demin *In its* Effect of Ionizing Radiation and Dyn. Factors of the Function of the Central Nervous System; Probl. in Space Physiol. 15 Sep. 1967 p 13–27 (See N68-33285 20-04)

Mice were subjected to 20 min of vertical vibration and irradiated with X-ray doses of 50 to 100 r. Four groups of mice were used. The first group was subjected to vibration alone and the second group was exposed to radiation alone. The third group was exposed to vibration followed 3 to 5 min later by irradiation, and the fourth group was exposed to irradiation followed 3 to 5 min later by vibration. It was found that vibration increases the number of mitoses in bone marrow cells. Most of the affected cells showed chromosome adhesions. The number of disturbed mitoses caused by the combined effects of vibration and irradiation did not exceed the number produced by the effects of radiation alone. However, some differences were noted in the types of changes encountered: exposure to combined factors increased the proportion of chromosome adhesions to chromosome aberrations. The mitotic activity picture in bone marrow exposed to a 50-r X-ray dose alone was similar to that produced by the combined effect of vibration and irradiation. Increasing the vibration frequency from 60 cps to 70 cps produced no statistically significant difference in the number of changes in mitotic activity. Author

N68-33333*# Johns Hopkins Univ., Baltimore, Md. School of Medicine.

BIOLOGICAL EXPERIMENTS IN SPACE. PSYCHOCARDIOVASCULAR REACTIONS DURING CONDITIONS OF WEIGHTLESSNESS IN AN ORBITING SATELLITE Final Status Report, Oct. 1963–Mar. 1968

Jorge Perez-Cruet Mar. 1968 211 p refs
(GRANT NsG-520)
(NASA-CR-96450) CFSTI: $3.00 CSCL 06S

Summary information is given on various experiments which were conducted to determine the possible effects of prolonged weightlessness on the neural control of cardiovascular functions. Methods and techniques for obtaining data on psychocardiovascular reactions under terrestrial laboratory conditions are detailed along with several models for the study of certain psychocardiovascular reactions. The physiological mechanisms mediating psychocardiovascular responses were explored by surgical removal of peripheral autonomic nerves and by pharmacological blockade of parasympathetic and adrenergic mechanisms. It was found that psychocardiovascular reactions depended on the integrity of these pathways. Mechansims mediating psychocardiovascular reactions are discussed in relation to experiments where the hypothalamus and other intracraneal areas were electrically stimulated. An assessment is also made of investigations in which the problem of inhibition of psychocardiovascular reactions was studied. B.S.D.

N68-33479 Washington Univ., Seattle.

KINETIC ISOTOPE STUDIES ON THE INACTIVATION OF TRANSFORMING DEOXYRIBONUCLEIC ACID, TOBACCO MOSAIC VIRUS, AND ITS NUCLEIC ACID BY ULTRAVIOLET LIGHT

Mariano Tao (Ph.D. Thesis) 1967 123 p
Available from Univ. Microfilms: HC $6.00/MF $3.00 Order No. 67-14224

The effect of solvent on the inactivation of transforming deoxyribonucleic acid, tobacco mosaic virus, and its nulceic acid by ultraviolet irradiation has been investigated. The rates of inactivation of TMV-RNA at 253.7 and 300 mμ radiation in heavy water are lower than in light water. The ratio of the rate constants, K_{H2O}/K_{D2O}, is about 2 for 253.7 and 300 mμ radiation. Pyrimidine dimers and hydrates have been isolated from tritiated TMV-RNA irradiated in H_2O and D_2O at 253.7 mμ. The isolation procedures involve ezymic hydrolysis and paper and column chromatography. The rates of formation of pyrimidine dimers in TMV-RNA irradiated in H_2O and D_2O are identical. This suggests that dimer formation is not affected by solvent. On the other hand, a deuterium isotope effect is observed for hydrate formation. The

deuterium isotope effect observed for hydrate formation is about 2.2, which is comparable to that observed for the inactivation of TMV-RNA. Dissert. Abstr.

N68-33506*# Childrens Hospital Medical Center of Northern Calif., Oakland. Bruce Lyon Memorial Research Lab.
DIETARY FACTORS AFFECTING EXOGENOUS AND ENDOGENOUS SOURCES OF FAT AND CARBOHYDRATE FOR ENERGY PRODUCTION AND SYNTHESIS Annual Progress Report, 1 Oct. 1967–30 Jun. 1968
S. Abraham and Mildred J. Bennett 1968 25 p refs
(Grant NGR-05-059-001)
(NASA-CR-96422) CFSTI: HC $3.00/MF $0.65 CSCL 06A

As a basis for assessing the effects of long duration space flight stress on astronauts, studies on rats were conducted to determine: the effects of diet composition on total fatty acid (TFA) content and changes in fatty acid composition of liver, adipose tissue, and carcass; the activities of enzymes related to fat and carbohydrate metabolism; and the rate of deposition or use of body fat. Rats were fed purified diets or combined purified-synthetic diets containing 0%, 11%, or 45% of the calories as fat. Dietary procedures and caloric intake are given, along with body weight measurements for the male and female animals. Some of the general conclusions reached are: (1) Epididymal and abdominal fat in the same animal have similar fatty acid compositions. (2) The metabolic activities of liver and adipose tissue are affected by diets high and low in fat. (3) The TFA content and fatty acid composition of liver is stable with respect to changes in dietary fat. B.P.

N68-33555*# Woods Hole Oceanographic Institution, Mass.
MOLECULAR STRUCTURE AND COMPOSITION OF FISH OTOLITHS
Egon T. Degens, Werner G. Deuser, and Richard L. Haedrich Aug. 1968 30 p refs *Its* Reference No. 68-56
(Contract NSR-22-014-001; Grants Am. Chem. Soc. PRF-1943A2; NSF GA-970)
(NASA-CR-96463) CFSTI: HC $3.00/MF $0.65 CSCL 06C

Information is presented on the origin of otoliths. Twenty-five species of wide phylogenetic and environmental range were studied and aragonite was the only major mineral form present. A fibrous protein serves as template for the epitaxial growth of aragonite. Electromicrographs reveal the structural interrelationships between the protein and the aragonite. The stable isotope distribution of the aragonite suggests that the otoliths are formed close to isotopic equilibrium with sea water or fresh water respectively. Phylogenetic, environmental, and physiological aspects are discussed. Author

05 BIOTECHNOLOGY

Includes life support systems, human engineering; protective clothing and equipment; crew training and evaluation, and piloting. For related information see also: 04 Biosciences.

N68-32256 Washington Univ., Seattle.
HUMAN TEMPERATURE REGULATION: DYNAMIC CHARACTERISTICS OF METABOLIC RESPONSE
George Leslie Brengelmann (Ph.D. Thesis) 1967 202 p
Available from Univ. Microfilms: HC $9.25/MF $3.00 Order No. 67-14154

Responses of human subjects to acute cold exposure were studied with the goal of quantitative description of the relationship between input variables and metabolic response, specifically including dynamic behavior. Subjects were exposed in a water bath. Bath temperature was varied in various temporal patterns chosen to bring dynamic properties to light. Oxygen consumption, meatus and rectal temperatures and bath temperature were monitored continuously. Results indicate that rate of change of skin temperature, dT_s/dt, is an important input which interacts with skin temperature and internal temperature to determine metabolic rate. This interaction is complicated by various nonlinearities particularly a threshold skin temperature involved with incorporation of dT_s/dt in control of metabolism. Dissert. Abstr.

N68-32259 Brandeis Univ., Waltham, Mass.
AUDITORY EFFECTS OF VISUAL REARRANGEMENT: INTERSENSORY CONFLICT AS A FACTOR IN ADAPTION
Jerold Herbert Rekosh (Ph.D. Thesis) 1967 144 p
Available from Univ. Microfilms: HC $6.80/MF $3.00 Order No. 67-16572

Compensation for displaced vision is considered from the viewpoint of a condition in which an artificially induced conflict between separate, but typically correlated channels of sensory information is created. Resolution of this conflict is considered necessary to restore normal sensory-motor performance. An hypothesis is developed that such resolution should require changes in intersensory relationships and the resulting compensation for the visual displacement should affect all other sensory modalities which contribute to spatially oriented behavior. This hypothesis is tested for the case of visual-and auditory relations. Subjects walked about while wearing laterally—displacing wedge prisms under two conditions of auditory stimulation, normal and attenuated. Before and after this exposure, visual and auditory direction-finding were measured. A series of experiments using this basic method led to the following results regarding the functioning of auditory-motor behavior during adaptation to visual rearrangement. Dissert. Abstr.

N68-32309 Ohio State Univ., Columbus.
THE NATURE OF INFORMATION LOSS IN THE VISUAL PREPERCEPTUAL SYSTEM
Michael Thomas Turvey (Ph.D. Thesis) 1967 59 p
Available from Univ. Microfilms: HC $3.00/MF $3.00 Order No. 67-16343

The present experiments explored further the nature of the visual preperceptual system (VPrS) in terms of the operative dimensions of storage and the nature of information loss. Experiment I was performed to assess the contention that an auditory code, phonemic in nature, evidenced at the postperceptual level was not operative at the preperceptual level. Stimulus materials were 3 x 5 letter matrices presented to *S* for a 50 msec. duration. The cue for retrieval was received by *S* 300 msecs. after the display terminated. Experiment II was conducted to verify the observation of a spatial code in the VPrS and to determine whether or not the information loss occurs with respect to this code. The protocol and displays of Experiment I was used with three delay intervals of 0 msec., 300 msec., 700 msec. A two-phase analysis of the data verified the existence of spatial dimensions of storage and revealed that as accuracy of retrieval decreased over time dimensional error-production systematically increased with omissions and other error-production remaining invariant. Experiment III, utilizing a new sample of 8 *Ss* and 3 x 5 digit matrices replicated this observation. It was concluded that visual preperceptual information is stored in spatial dimensions and that this spatial information decays systematically as a function of time in store. Dissert. Abstr.

N68-32407# Institute for Perception RVO-TNO Soesterberg (Netherlands).
THE NON-EXPERIENCE OF DURATION DURING A CHOICE REACTION TASK
John A. Michon [1968] 13 p refs
(IZF-1968-10; TDCK-50905) CFSTI: HC $3.00/MF $0.65

Short interruptions of up to 0.4 sec in the active processing of information may remain unnoticed in subjective experience of duration. In the two experiments reported it is shown that such interruptions actually affect time estimation in a way which is predicted by the cognitive theory of time perception. Author

N68-32451# Chemical Lab. RVO-TNO, Rijswijk (Netherlands).
AIR REGENERATION IN SEALED ENVIRONMENTS, A LITERATURE SURVEY [LUCHTZUIVERING IN GESLOTEN RUIMTEN. EEN LITERATUUROVERZICHT]
P. Sluimer Mar. 1968 40 p refs In DUTCH; ENGLISH Summary
(TDCK-50963; Rept.-1968-2) CFSTI: HC $3.00/MF $0.65

A literature survey is given for systems for air regeneration. Attention was paid mainly to pure chemical systems. Electrochemical and biochemical systems are dealt with only briefly. Special attention was given to combined sources of oxygen evolution and carbondioxide absorption. A comparison of several systems concerning weight, volume and heat evolution has been made. Author

N68-32506 National Lending Library for Science and Technology, Boston Spa (England).
THE PROBLEM OF PSYCHOLOGICAL FACTORS OF THE DIRECTION OF THINKING IN THE PROCESS OF SOLVING PROBLEMS [K VOPROSU O PSIKHOLOGICHESKICH FAKTORACH NAPRAVLENNOSTI MYSHLENIYA V PROTSESSE RESHENIYA ZADACHI]
N. L. Eliava Feb. 1968 8 p refs Transl. into ENGLISH from Psikhologicheskii Issled. im A.S. Prangishvili (USSR), 1966 p 200-205
(RTS-4098) Available from Natl. Lending Library, Boston Spa, Engl.: 15s

Psychological factors underlying the direction of thinking during problem solving were investigated in two experiments that required the subjects to group stories according to difficulties associated with the actual procedure of classification, and according to difficulties which arose in connection with the work done in preceding stages. In both cases the set formed in the subject's immediate past was apparent in his further activity. Experimental data indicated that sudden change in the relation of the subject to the reading text was accomplished with the participation of a psychological activity on the basis of which the thinking process changed its direction. In the theory of the set this activity was represented as the concept of the act of objectivation. G. G.

N68-32519# Rhode Island Univ., Kingston.
FLOW OF HEAT AND VAPOR THROUGH COMPOSITE PERM-SELECTIVE MEMBRANES UNDER SIMULATED CONDITIONS Final Technical Report, Jan. 1967-Jan. 1968
Ferdinand Votta, Jr. 1968 38 p
(Contract DAAG17-67-C-0061)
(TR-68-44-CM; AD-671681)

An experimental study was made of the heat and mass (water vapor) flow rate through several different composite clothing systems. Cooling of a simulated skin surface was obtained through vaporization of water from a wet wick in the clothing system. Tests were conducted at both reduced and at atmospheric pressure. In the reduced pressure tests, cooling rates as high as 182 Btu/(hr. x sq.ft.) were obtained with a simulated skin temperature of 91F. Excellent control of the simulated skin temperature at widely varying heat flow rates was possible. Temperature control was obtained by controlling the wick vaporization pressure. Both forced and natural convection were used in the atmospheric pressure tests. Forced convection was obtained by blowing air from a large fan across the surface of the clothing systems. The air velocity was approximately 7 ft./sec. While the heat flow rate depended somewhat upon the temperature and the humidity of the room air, which were not controlled in these tests, the results indicated that high cooling rates were possible. For a simulated skin temperature of 91F, cooling rates as high as 200 Btu/(hr. x sq. ft.) for forced convection and 121 Btu/(hr. x sq. ft.) for natural convection were obtained, with room air. Author (TAB)

N68-32573 California Univ., Los Angeles
SCENE POLARIZATION MEASUREMENTS BY PHOTOGRAPHIC PHOTOMETRY
Robert Philip Borofka (Ph.D. Thesis) 1967 124 p
Available from Univ. Microfilms: HC $6.00/MF $3.00 Order No. 67-14250

A measurement technique has been developed which is suitable for measuring the degree of polarization of different parts of a visual task. This measuring concept is suitable for easy field use under a diversity of lighting conditions and types of tasks. For a given task three photographs are taken through a linear polarizer, angularly oriented in three different directions; specifically, horizontal, vertical, and at 45°. Microdensitometer measurements of selected positions in the three resulting images can allow the degree of polarization to be determined for the corresponding locations in the scene. The interdependencies of the various measurement parameters are developed and the effects of errors analyzed. The constructional aspects are also given for the physical system used to verify the performance of the measuring technique. The computer program used for data processing is described and the results provided for a variety of task measurements. Dissert. Abstr.

N68-32733*# Naval School of Aviation Medicine, Pensacola, Fla.
INSTRUMENTATION FOR MEASUREMENT OF VESTIBULAR-SIGNIFICANT FORCES IN HELICOPTERS
W. Carroll Hixson and Jorma I. Niven 21 May 1968 17 p
(NASA Order R-93)
(NASA-CR-96296; NAMI-1043; AD-670230) CFSTI: HC $3.00/MF $0.65 CSCL 06B

The report describes an airborne instrumentation system developed at minimal cost from standard, commercially available components for the in-flight acquisition and storage of helicopter low-frequency motion data pertinent to the investigation of vestibular-related pilot disorientation. System components provided to measure and record the instantaneous triaxial linear acceleration and instantaneous triaxial angular velocity of the aircraft at a given crew station include three potentiometer readout linear accelerometers, three similar gimballess rate gyros, six signal-conditioning amplifiers, and a 7-channel, battery-powered, IRIG-compatible, magnetic tape recorder. Author (TAB)

N68-32734*# Naval School of Aviation Medicine, Pensacola, Fla.
A TRIAXIAL ACCELEROMETER MODULE FOR VESTIBULAR APPLICATION
W. Carroll Hixson 7 May 1968 17 p ref
(NASA Order R-93)
(NASA-CR-96298; NAMI-1040; AD-670231) CSCL 06B

A brief description is given of a 6-channel instrumentation module developed for collection of preliminary acceleration data for the a priori determination of optimal characteristics for transducers to be installed permanently on various aircraft and man-rated research devices for the measurement of vestibular-significant acceleration stimuli. The module utilizes three linear and three angular accelerometers, all of the standard, commercially available, servo type, to measure the triaxial linear and triaxial angular accelerations, along and about, respectively, the roll, pitch, and yaw axes of the test device or vehicle. Signal-conditioning amplifiers equipped with feedback circuitry to facilitate in-flight adjustment of gain and high-frequency rolloff characteristics are provided for optimal utilization of the dynamic range capabilities of magnetic

tape data storage recorders. Though the instrument is used primarily to collect acceleration data in the 0-5 cps spectrum, the linear channels can also be used in determining vibration levels in the 0-100 cps range. Author (TAB)

N68-32747*# Techtran Corp., Glen Burnie, Md.
X-RAY DOSIMETER [DOSIMETRE A RAYONS X]
Washington NASA Aug. 1968 8 p Transl. into ENGLISH from French Patent No. 1035715, 1953 5 p
(Contract NASw-1695)
(NASA-TT-F-11906) CFSTI: HC $3.00/MF $0.65 CSCL 06B

The invention concerns dosimeters for measuring the intensity of the dose, or both, of X-or gamma rays administered to a body at a given location. The essential characteristic consists of a cell whose part sensitive to X-or gamma rays consists of a semiconducting layer or material, and in the fact that this cell is mounted in a suitable circuit for measuring variations of the resistance of this cell under X-or gamma radiation. Author

N68-32749# Bunker-Ramo Corp., Canoga Park, Calif.
EFFECTS OF FAILURE TYPE, FAILURE ALTITUDE AND AN EXPERIMENTAL PITCH TRIM AUGMENTATION UPON MANDATORY GO-AROUND PERFORMANCE, PHASE 4 Final Report, 20 Oct.–3 Nov. 1967
C. A. Semple, S. B. Stewart, S. F. Barnebey, and D. E. Nichols Feb. 1968 43 p refs
(Contract FA-67-WA-1700)
(SRDS-RD-68-12; AD-671893)

Ten rated pilots flew 320 fully automatic Category III-C (zero visibility) approaches to landing in a simulator study designed to investigate mandatory go-around performance following control and display system failures at 70, 40, 30 and 20 feet of actual altitude. The utility of an experimental pitch trim augmentation condition which automatically resulted in a 0.25 degree per second pitch-up rate following autopilot failure or disconnect also was investigated. In order to explore the utility of a rollout steering command, one hundred and twenty additional automatic landings were also made, followed by manually controlled rollout to 60 knots. Touchdown performance also was examined. Based upon the severity of sink rates at touchdown, the study showed that automatic landing performance is slightly better than go-around performance when autopilot functioning is unimpaired by system failures. System survivability also was shown to be better if mandatory go-around rather than manually controlled touchdown followed autopilot failures. The experimental pitch trim augmentation also facilitated go-around performance not only by reducing the number of ground strikes but also by reducing the severity of sink rates at the time of ground strike. Although rollout performance was unsatisfactory, the rollout steering command proved promising. As a minimum, additional improvement in the composition of a rollout steering command signal would be required to make manually controlled instrument rollout practical. Author (TAB)

N68-32814# Houston Engineering Research Corp., Tex.
MATCH-TO-SUCCESSIVE-SAMPLE-DEVICE SYSTEM WITH PAPER TAPE INPUT/OUTPUT UNIT Final Report
Gordon L. Wilson, A. H. McMorris, and E. G. Rogers Holloman AFB, N. Mex. Aeromed. Res. Lab. May 1968 29 p
(Contracts AF 29(600)-4003; AF 29(600)-5642)
(ARL-TR-68-4; AD-671985)

This technical report describes a special purpose, stored and wired program system for automatically administering match-to-successive-sample problems to primates, the Match-to-Successive-Sample Device (MSSD) system. The system uses visual and/or auditory stimuli for communication with the subject. Since the MSSD system is fully automatic, any number of consecutive problems with variable parameters can be administered without intervention from the experimenter. The input data for each problem are automatically recorded on punched cards or paper tape. In addition to automatically recording the input data, the MSSD system also records each response and indicates whether or not the response was correct. Positive and negative reinforcement are administered at the conclusion of each problem, depending on the reinforcement modes programmed by the experimenter. Author (TAB)

N68-32801# Joint Publications Research Service, Washington, D. C.
LIFE SUPPORT OF SPACECRAFT CREWS
G. I. Voronin and A. I. Polivoda 12 Aug. 1968 216 p refs Transl. into ENGLISH from Mashinostr. (Kiev), 1967
(JPRS-46173)

A brief comparative analysis of the weight and power characteristics of the principal types of life support systems, including those with reserves of oxygen, water and food, those using physical and chemical air and water regenerators, those using autonomous power plants and radiation heat exchangers, is presented; also, systems are described with biosynthesis of food matter and simultaneous oxygen regeneration. The book presents a brief analysis of the principles of bioenergetics in its scientific and engineering aspects. Author

N68-32920# Federal Aviation Administration, Oklahoma City, Okla.
THE SPIRAL AFTEREFFECT: INFLUENCE OF STIMULUS SIZE AND VIEWING DISTANCE ON THE DURATION OF ILLUSORY MOTION
William E. Collins and David J. Schroeder May 1968 9 p refs
(FAA-AM-68-10)

This study examined some effects of stimulus size and distance on the persistence of one type of illusory motion, viz., the spiral aftereffect (SAE). Duration of SAE was investigated with stimuli of 2, 4, 8, 12, 14, and 16 inches in diameter. The distance between the observers and the rotating spirals was varied to produce visual angles between 1°12′ and 18°56′ of arc. Data indicate that the duration of illusory motion reaches peak values between approximately 2°–4° of visual angle. Author

N68-32943# Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.
CHARACTERISTICS OF TEFLON-LITHIUM FLUORIDE THERMOLUMINESCENT DOSIMETERS
G. W. R. Endres Jan. 1968 22 p refs Presented at the Symp. on Personnel Radiation Dosimetry, Chicago, 30 Jan.–1 Feb. 1967
(Contract AT(45-1)-1830)
(BNWL-741; CONF-670115-2) CFSTI: HC $3.00/MF $0.65

The characteristics of thermoluminescent teflon–lithium fluoride finger rings for personnel dosimetry are investigated. The discs require a minimum of handling, do not need processing before readout, and may be loaded in normal room light without inducing spurious readings. The relatively flat energy response eliminates the necessity for making large corrections when working with low energy radiation sources. And generally, the measurements are more accurate than those obtained using film. NSA

N68-32973*# Minnesota Univ., Minneapolis.
DEVELOPMENT AND EVALUATION OF AN IMPEDANCE CARDIOGRAPHIC SYSTEM TO MEASURE CARDIAC OUTPUT. DEVELOPMENT OF AN OXYGEN CONSUMPTION RATE COMPUTING SYSTEM UTILIZING A QUADRUPOLE MASS SPECTROMETER

W. G. Kubicek, D. A. Witsoe, R. P. Patterson, M. A. Mosharrafa, J. N. Karnegis et al Jul. 1967 185 p refs
(Contract NA59-4500)
(NASA-CR-92220) CFSTI: HC $3.00/MF $0.65 CSCL 06B

A four electrode impedance plethysmographic system was developed which apparently monitors left ventricular output. Two band electrodes were placed around the subject's neck, a third band around the thorax at the level of the xiphisternal joint, and the fourth around the lower abdomen. The upper neck electrode and the abdomen electrode were excited by a 100 kHz constant sinusoidal current and the resultant voltage (impedance) changes occurring with the cardiac cycle were monitored from the inner two electrodes. Stroke volume was calculated from the impedance change information using a formula relating impedance changes to volume changes in a conducting solid. A comparison study with simultaneous impedance and dye dilution measurements under rest and exercise conditions was carried out on 10 healthy young adult males. Results indicate that the impedance method predicts relative changes (ratios) in cardiac output with an accuracy of ± 16 percent with 95 percent confidence. Author

N68-33009*# Boeing Co., Philadelphia, Pa.
SUBJECTIVE RESPONSE TO SYNTHESIZED FLIGHT NOISE SIGNATURES OF SEVERAL TYPES OF V/STOL AIRCRAFT
Ernest G. Hinterkeuser and Harry Sternfeld, Jr. Washington NASA Aug. 1968 98 p refs
(Contract NAS1-7083)
(NASA-CR-1118; D8-0907A) CFSTI: HC $3.00/MF $0.65 CSCL 05E

The acoustical signatures of various types of V/STOL aircraft sized for 60 passengers and a 500 mile range were analytically predicted, and tape recordings synthesizing these sounds were prepared. Test subjects listened to these sounds and compared their annoyance with that of a jet airplane. Perceived noise levels were calculated, and the levels which produced equal annoyance to the jet were determined. Each aircraft was analyzed to determine the distance it must maintain from observers in order not to exceed the annoyance of the jet airplane during terminal and flight operations. A second analysis was made to identify the noise reduction required for each aircraft in order to operate at specified distances at a specified level of annoyance. The aircraft studied were helicopters, fan lift, jet lift, and tilt wing VTOL and a turbofan STOL. Author

N68-33093*# Cornell Aeronautical Lab., Inc., Buffalo, N. Y.
SOME EFFECTS OF Y-AXIS VIBRATION ON VISUAL ACUITY Final Report, Jul. 1966–Nov. 1967
L. Rubinstein and R. Kaplan Wright-Patterson AFB, Ohio AMRL Jun. 1968 29 p refs
(NASA Order T-55353; Contract AF 33(615)-5279)
(NASA-CR-96466; CAL-VH-2298-B-1; AMRL-TR-68-19) CFSTI: HC $3.00/MF $0.65 CSCL 05E

Four experiments were conducted to measure vernier visual acuity during sinusoidal vibration of the head in the y-axis (side to side). In one half of each experiment peak acceleration amplitude was held constant at 1.0 G_y; in the other half, displacement amplitude was held constant at 0.03 cm. Frequency was the main independent variable. Experiments 1 and 2 examined the effects of vibrating the head at frequencies ranging from 13 to 78 Hz. The combined results from these experiments showed that in both the constant acceleration and the constant displacement conditions acuity is a U-shaped function of frequency and has a minimum in the frequency range of 26 to 34 Hz. Experiment 3 examined the effects of vibrating the target. Decrements in acuity due to target vibration were smaller than those due to head vibration under comparable conditions. Experiment 4 examined the effects of vibrating the head using procedures similar to those in experiments 1 and 2 except that the orientation of the vernier target with respect to the axis of vibration was changed from perpendicular (i.e., vertical) to parallel, (i.e., horizontal). No differences were found between the acuity scores produced by the vertically and horizontally oriented targets, for either the constant displacement or the constant acceleration condition. Author

N68-33241*# Massachusetts Inst. of Tech., Cambridge. Man-Vehicle Lab.
STUDIES OF HUMAN DYNAMIC SPACE ORIENTATION USING TECHNIQUES OF CONTROL THEORY Status Report, Jun. 1967–Jun. 1968
L. R. Young and Y. T. Li Jun. 1968 41 p refs
(Grant NsG-577)
(NASA-CR-96290) CFSTI: HC $3.00/MF $0.65 CSCL 05H

The research topics are all concerned with transmission of orientation information to a man, his manual control process thereafter, and the resulting manual output. The research areas are thus classified according to presentation of information (display research), physiological sensor modeling (vestibular system and eye movements), manual control modeling, and output mechanisms (postural and neuromuscular control). Author

N68-33296*# General Dynamics/Convair, San Diego, Calif.
FEASIBILITY STUDY OF A CENTRIFUGE EXPERIMENT FOR THE APOLLO APPLICATIONS PROGRAM. VOLUME 1: SPACE RESEARCH CENTRIFUGE CONFIGURATION, INSTALLATION AND FEASIBILITY STUDIES Final Report
B. D. Newsom et al 25 Mar. 1968 360 p refs
(Contract NAS1-7309)
(NASA-CR-66649; GD/C-DCL-68-001; SRC-AN-703) CFSTI: HC $3.00/MF $0.65 CSCL 06B

The feasibility of employing an orbital, onboard centrifuge to perform a series of physiological experiments with human subjects in space is examined. An initial trade-off study was employed to reduce the centrifuge and installation configuration to a single, well-defined baseline, and orbital spacecraft installations were evaluated. The candidate installations selected are the S-4B ground fitted station, an S-4B workshop cluster, and a CSM/LM; for compatibility, an 8.5 foot centrifuge radius is recommended. In analyzing the stability and control dynamics, the effect of spacecraft perturbation on the centrifuge experiment was considered, as well as vehicle stabilization. Comparison of experiment requirements with the spacecraft control capability indicates that sufficient stability can be achieved. The orbital centrifuge design criteria are identified as primary rotation, radius arm translation, couch pivot drive, couch roll drive, and couch translation and body adjustments. Feasibility data were also developed on reliability, failure mode and effects, safety, cost, weight, power, life support, and environmental control. The experiment is considered technologically feasible. M.G.J.

N68-33297*# General Dynamics/Convair, San Diego, Calif.
FEASIBILITY STUDY OF A CENTRIFUGE EXPERIMENT FOR THE APOLLO APPLICATIONS PROGRAM. VOLUME 2: SPECIFICATION AND TEST REQUIREMENTS SPACE RESEARCH CENTRIFUGE ENGINEERING DEVELOPMENT PROTOTYPE Final Report
1 Apr. 1968 165 p refs
(Contract NAS1-7309)
(NASA-CR-66650; GD/C-DCL-68-002; SRC-SD-604) CFSTI: HC $3.00/MF $0.65 CSCL 06B

General, subsystem, and test specifications are presented for developing the space research centrifuge engineering prototype. System level requirements are established for the detail design and fabrication of a ground-based prototype to support the T-010 experiments proposed for the Apollo Applications Program. This system will be used initially to develop mechanisms and control systems, and to verify the performance capabilities of prototype

hardware. These data are to form the basis for developing the ground-based centrifuge into a man-rated test facility to evaluate physical tolerances, training requirements, and man–machine integration during the experiment definition phase. Design criteria are stated for the electrical instrumentation and control; subsystem specifications cover the drive hub and sensor, primary drive, counterbalance, radius arm translation drive, pivot drive, roll drive, and couch for one man occupancy in a shirt sleeve environment. Test procedures and reporting requirements are outlined. M.G.J.

N68-33298*# General Dynamics/Convair, San Diego, Calif.
FEASIBILITY STUDY OF A CENTRIFUGE EXPERIMENT FOR THE APOLLO APPLICATIONS PROGRAM. VOLUME 3: EXPERIMENTAL REQUIREMENTS FOR THE SPACE RESEARCH CENTRIFUGE Final Report
W. A. Johnson et al. 1 Apr. 1968 137 p refs
(Contract NAS1-7309)
(NASA-CR-66651; GD/C-DCL-68-003; SRC-MS-112) CFSTI: HC $3.00/MF $0.65 CSCL 06B

The application of an onboard centrifuge for measuring human physiological responses in the space environment is examined. The centrifuge design is to be applicable to both the LM laboratory and the advanced workshop S-4B concepts. As the centrifuge provides the angular velocities and accelerations in one plane, the subject interfaces with the centrifuge by means of the couch-restraint system which provides the correct orientation, secondary angular velocities and accelerations, and the manipulations required to investigate the subjects' responses. The measurement instrumentation is to be incorporated into the couch assembly. The experiments are discussed in relation to couch positions, accelerations, type of restraints, degrees of freedom, and experimental instrumentation. They include the use of peripheral vision lights for studying grayout thresholds, therapeutic support, threshold levels of sensitivity for angular acceleration, tolerance to tilt simulation, cross-coupled semicircular canal stimulation, threshold levels of sensitivity to linear acceleration, and reentry simulation. Experiment feasibility is assessed in terms of spacecraft stability, reliability, safety, economics, weight, and power. M.G.J.

N68-33304*# Bolt, Beranek, and Newman, Inc., Cambridge, Mass.
THE HUMAN AS AN OPTIMAL CONTROLLER AND INFORMATION PROCESSOR
Sheldon Baron and David L. Kleinman Washington Sep. 1968 76 p refs
(Contract NAS12-104)
(NASA-CR-1151; Rept.-1571) CFSTI: HC $3.00/MF $0.65 CSCL 05H

A mathematical model of the human operator in multivariable control tasks is developed by considering the human as a control and information-processing system. The model contains elements for describing the operator's inherent physiological limitations as well as his instrument-monitoring, data-reconstruction, and control behavior. Special emphasis is placed on the instrument-monitoring aspects of the model. The human's limitations are modelled by combining them into an equivalent perceptual time delay and an equivalent observation noise. The main assumption underlying the subsequent theoretical investigations is that the well-trained, well-motivated operator behaves in a near optimal manner, subject to the constraints imposed by the above limitations. Thus, the operator's control behavior is assumed to be that of an ideal feedback controller. The human's data-reconstruction process is chosen so as to obtain a "best" estimate of the state of the controlled element based on information obtained from "sampling" the various instruments. Author

N68-33437*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
STUDIES OF PILOTING PROBLEMS OF ONE-MAN FLYING UNITS OPERATED IN SIMULATED LUNAR GRAVITY
Donald E. Hewes Aug. 1968 16 p refs Presented at the 2d Natl. Conf. on Space Maintenance and Extravehicular Activities, Las Vegas, Nev., 6–8 Aug. 1968
(NASA-TM-X-61164) CFSTI: HC $3.00/MF $0.65 CSCL 05E

Current interests in small flying units to extend the range capabilities of lunar explorers coupled with a serous lack of information on the flight behavior of such vehicles have stimulated a series of studies of the handling qualities and often piloting problems of this type of vehicle. This paper briefly reviews earlier experimental studies of small earth-based vehicles and illustrates several configurations that have evolved in recent preliminary design studies of possible small lunar flying devices. These configurations include backmounted, stand-up, and sit-down arrangements that are being, or soon will be, evaluated in the Langley studies made possible by the recent development of lunar gravity simulation techniques that permit the use of full-scale man-operated flying test-bed vehicles. The general nature of these fundamental studies as well as a few of the preliminary findings are described in this paper. Author

N68-33452*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
HUMAN WORK PERFORMANCE IN SPACE
Otto F. Trout, Jr. and Paul R. Hill [1968] 8 p Presented at the 2nd Natl. Conf. on Space Maintenance and Extravehicular Activities, Las Vegas, Nev., 6–8 Aug. 1968
(NASA-TM-X-61160) CFSTI: $3.00 CSCL 05H

Methods of manual performance of extravehicular and intravehicular work in space are being investigated by means of simulation techniques in order to develop locomotion and restraint aids, equipment design data, and manual task procedures. Simulation and flight experiences to date have provided insight into problem areas for application to maintenance, repair, and assembly tasks during space-flight operations. Author

N68-33498# Battelle Memorial Inst., Richland, Wash. Pacific Northwest Lab.
EFFECT OF ATMOSPHERIC TRITIUM ON PHOTOGRAPHIC, THERMOLUMINESCENT AND RADIOPHOTOLUMINESCENT DOSIMETERS
Dale H. Denham and Ronald L. Kathren 20 Jun. 1968 10 p refs Presented at the Health Phys. Soc. Meeting, Denver, 16–20 Jun. 1968
(Contract AT(45-1)-1830)
(BNWL-SA-1569; CONF-680607-2) CFSTI: HC $3.00/MF $0.65

^{7}LiF thermoluminescent dosimeters, in teflon or as extruded rods, low Z radiophotoluminescent glass, and personnel monitoring film were exposed to 1, 4, 40 and 200 MPC (5, 20, 200, 1000 $\mu Ci/M^3$) of tritiated water in air at 52% relative humidity. Neither the TLD nor RPL glass dosimeters responded to the tritium over an exposure range of 4 and 4800 MPC-hours. Hence, these dosimeters cannot be used as atmospheric tritium detectors nor is protection required if they are worn by personnel in tritium contaminated atmospheres. Personnel monitoring film was affected by atmospheric tritium with the response per unit exposure being concentration dependent for exposure times below about 200 hours. The use of film as a tritium dosimeter is contraindicated unless tritium concentrations are reasonably constant or the exposure is made over a long period of time. A heat sealed pouch of 0.005 inch polyethylene will adequately protect the film badges of workers in tritiated atmospheres. Author (NSA)

06 CHEMISTRY

Includes chemical analysis and identification (e.g., spectroscopy). For applications see: 17 Materials, Metallic; 18 Materials, Nonmetallic; and 27 Propellants.

N68-32238 Rice Univ., Houston, Tex.
LOW TEMPERATURE VAPOR—LIQUID EQUILIBRIA OF HYDROCARBONS: THE METHANE-N-HEPTANE, METHANE-TOLUENE AND METHANE-METHYLCYCLOHEXANE SYSTEMS
Harry Lo Chang (Ph.D. Thesis) 1967 171 p
Available from Univ. Microfilms: HC $8.00/MF $3.00 Order No. 67-13059

The vapor recycle method was used to determine binary vapor-liquid equilibrium data for methane, n-heptane, methylcyclohexane and toluene in the binary systems of methane-n-heptane, methane-methylchclohexane and methane-toluene at low temperatures and high pressures. Phase compositions and equilibrium constants for each component were determined at temperatures of 0, −20, −40, −60, −80 and −100°F and at pressures from 100 psia up to the critical pressures for methane-n-heptane and methane-methylcyclohexane systems and up to 3500 psia for the methane-toluene system. Low temperature three - and four-phase conditions were also determined for the binary systems. The experimental results compared favorably with comparable literature data and showed good internal consistency. From an error analysis, the maximum error in the experimental K-values was estimated to be less than 2% for methane and 5% for the heavier components. Dissert. Abstr.

N68-32239 Texas Univ., Austin.
THE INFLUENCE OF POLAR COMPOUNDS ON THE SELECTIVITY OF HYDROCARBON SYSTEMS AT INFINITE DILUTION
Jimmy Luther Humphrey (Ph.D. Thesis) 1967 160 p
Available from Univ. Microfilms: HC $7.40/MF $3.00 Order No. 67-14846

Binary vapor-liquid equilibrium data were determined for n-butylamine, diethylamine, n-hexylamine, di-n-propylamine, diisopropylamine, and triethylamine with each of the hydro-carbons, n-hexane and hexene-1, at 60°C. Normally seven differing composition points were determined for each binary. Experimental activity coefficients were corrected for vapor phase imperfection and were found to be thermodynamically consistent by application of the Redlich—Kister consistency test. Activity coefficients were satisfactorily correlated with composition by use of the Wilson equation. The Wilson parameters were determined by limiting activity coefficients. Experimental hydrocarbon selectivities were combined with other data in order to investigate the behavior of strong hydro-bonding solvents relative to other polar compounds which do not form strong hydrogen-bonds. Dissert. Abstr.

N68-32243 Rice Univ., Houston, Tex.
SELF-DIFFUSION IN METHANE
Charles Rapier Dawson, Jr. (Ph.D. Thesis) 1967 127 p
Available from Univ. Microfilms: HC $6.20/MF $3.00 Order No. 67-13065

A pulsed NMR spectrometer has been used to measure the self-diffusion coefficient of methane from 154°K to 354°K and from 200 psi to 6000 psi. The critical constants of methane are 190.77°K and 671 psi. At the higher temperatures the density-diffusivity product, ρD, was essentially constant up to the critical density; above the critical density ρD decreased sharply. At temperatures closer to the critical ($T_r \sim 1.5$) a broad maximum in ρD appeared at the critical density. This maximum became more pronounced at lower temperatures and at the critical temperature ρD increased by a factor of about 2.0 between lower densities and the critical density. At all temperatures ρD decreased rapidly as the liquid densities were reached. The data were put in a reduced form using the critical temperature and density. The ρD product was reduced with $(\rho D)^*$, the low density value at the same temperature. The reduced data showed good agreement with data of other investigators in hydrogen and carbon dioxide. Dissert. Abstr.

N68-32264 Northwestern Univ., Evanston, Ill.
CHEMISTRY OF TRICHLOROGERMANATE(II) SALTS
Paul Stanley Poskozim (Ph.D. Thesis) 1967 98 p
Available from Univ. Microfilms: HC $5.00/MF $3.00 Order No. 67-15315

Research into the preparation and chemical reactions of trichlorogermyllithium led to the reinvestigation of the chemistry of germanium(II) complex salts and to the general study of the divalent state of germanium. A series of salts $M^+GeCl_3^-$[M = K+, Cs+, $(CH_3)_3N$+H, $(C_6H_5)_4As^+$] was prepared, and the bonding in a double-salt, $GeCl_2.Ge(H_2PO_2)_2$ investigated by nmr and infrared spectra/methods. The new germanium(II) salt, trichlorogermylpotassium, was obtained when hydrochloric acid and potassium chloride were added to precipitated germanium(II) hydroxide. The chemical reactions of trichlorogermylcesium were studied in detail and the previously unreported compounds t-butyltrichlorogermane and sec-butyltrichlorogermane and their triphenyl derivatives were prepared and characterized. The trichlorogermyl anion of $Cs^+GeCl_3^-$ reacted with primary and sterically unhindered secondary alkyl iodides, but the $GeCl_3^-$ species was generally found to be a poor nucleophile. Dissert. Abstr.

N68-32265 Northwestern Univ., Evanston, Ill.
MASS SPECTROMETRIC AND THEORETICAL STUDIES OF BORON NITROGEN SYSTEMS
Paul Martin Kuznesof (Ph.D. Thesis) 1967 305 p
Available from Univ. Microfilms: HC $13.75/MF $3.95 Order No. 67-15269

In Part I, a molecular beam mass spectrometric investigation of the vapors above solid BH_3NH_3 is discussed. The study was undertaken with the hope of detecting BH_2NH_2 and BHNH, the ethylene and acetylene analogs in the boron–nitrogen system. At room temperature, H_2, B_2H_6, NH_3, gaseous BH_3NH_3, and BH_2NH_2 are present in the vapor. Extensive pyrolytic decomposition of gaseous BH_3NH_3 occurs above 200°C and the relative abundances of B_2H_6, NH_3, and BH_2NH_2 to BH_3NH_3 increase rapidly. In Part II, the influence of methyl substituent effects on the electronic properties of boron–nitrogen systems is discussed. Electron impact ionization potentials of $(HBNCH_3)_3$ and $(CH_3BNCH_3)_3$ are presented. The ionization potentials of $(HBNH)_3$ and $(CH_3BNH)_3$ were redetermined and new values are reported. A mass spectrum of $(HBNCH_3)_3$ also is given. Semi-empirical SCF molecular orbital calculations were performed to correlate ionization potentials and electronic spectra of the borazines and dipole moments of the methylamineboranes. Dissert. Abstr.

N68-32266 Michigan Univ., Ann Arbor.
CONFORMATION AND DYNAMICS OF POLYMER CHAINS
Gerard Jannink (Ph.D. Thesis) 1967 167 p
Available from Univ. Microfilms: HC $7.80/MF $3.00 Order No. 67-15639

We consider the relation berween conformation, normal frequency distribution, and force field of a backbone chain. In particular, it is asked whether a conformation can be identified from the analysis of the frequency distribution and whether information about the force field can be gained by examining the frequency distribution at different conformations. To determine the frequency distribution, we use the symmetry of the dynamical matrix and the

property of Sturm sequences. We discuss the performances of the Givens' transformation and the negative eigenvalue theorem of Dean and Bacon. We conclude that conformations have two characteristic parameters reflected in the frequency distribution, namely the range of allowed dihedral angular values and the ordering of configurations along the chain. The frequency distribution for a given conformation depends, however, on the force constants ratio when the number of degrees of freedom is greater than one. Hence, the interpretation of frequency distributions is to be made in terms of both conformations and force field. Dissert. Abstr.

N68-32267 Michigan State Univ., East Lansing.
NUCLEAR MAGNETIC RESONANCE STUDY OF ANTIFERROMAGNETIC $Rb_2MnCl_4\ 2H_2O$
John Addis Casey (Ph.D. Thesis) 1967 55 p
Available from Univ. Microfilms: HC $3.00/MF $3.00 Order No. 67-14485

Proton, chlorine and rubidium nuclear magnetic resonance have been studied in triclinic crystals of $Rb_2MnCl_4\ 2H_2O$ which become antiferromagnetically ordered at $T_N = 2.24°K$. At 1.1°K two proton lines were found at 18.96 MHz and 18.30 MHz and their angular dependence in a small applied field fixes the magnetic space group as $P_i\bar{1}$. The angular variation of the resonance lines in the presence of a small external field was analyzed using the second moment of the Hamiltonian to determine the direction of the internal fields at the chlorine and rubidium sites. The chlorine internal fields are nearly parallel and with this taken as the direction of magnetization, computer programs were used to calculate the magnitude and direction of internal fields at the various nuclei. The internal fields were calculated for each of the magnetic lattices allowed by magnetic space group $P_i\bar{1}$ and compared with the measured fields. Dissert. Abstr.

N68-32276 Harvard Univ., Cambridge, Mass.
A DOUBLE RESONANCE MODULATED MICROWAVE SPECTROMETER AND ITS APPLICATIONS, THE MICROWAVE SPECTRUM OF PIVALALDEHYDE, INVESTIGATIONS OF COLLISIONAL TRANSFER OF ROTATIONAL ENERGY
Avigdor Meir Ronn (Ph.D. Thesis) 1967 127 p
Available from Univ. Microfilms: HC $6.20/MF $3.00 Order No. 67-11690

A practical non-Stark modulated double resonance microwave spectrometer has been constructed and tested in which frequency modulation is applied to one (strong) microwave source, the power from which passes through the sample gas but is prevented from reaching the crystal by filters. The microwave spectrum of pivalaldehyde, $(CH_3)_3CCHO$, has been investigated in the 9–40 Gc/sec region. The ground state, first and second excited states of the tertiary butyl torsion and the first excited torsional state of each of the three methyl groups have been assigned. Relative intensity and dipole moment measurement techniques utilizing the double resonance modulated spectrometer have been investigated. The latter are discussed and compared with the Stark modulated methods. Several relaxation phenomena were studied utilizing the double resonance techniques. Dissert. Abstr.

N68-32289 Texas Univ., Austin.
THE MECHANISM OF THE CORROSION OF IRON IN THE AMMONIUM NITRATE AMMONIA WATER SYSTEM
David Crosley Jones (Ph.D. Thesis) 1967 47 p
Available from Univ. Microfilms: HC $3.00/MF $3.00 Order No. 67-14850

The corrosion of iron in the NH_4NO_3–NH_3–H_2O system was studied using a rotating electrode with an iron disk and a platinum ring. The cathodic reaction was shown by analysis of the solution and by mass spectrometer experiments using N-15 isotope nitrate to be reduction of nitrate to nitrite, with some subsequent reduction of nitrite to ammonia. Ammonium ion is also believed to participate in the cathodic reaction. The anodic reaction was found to involve, the formation of a soluble ferrous ion species, found to be an iron-ammonia complex. That the ferrous ion does not precipitate in place in this basic system is in part responsible for the high corrosion rates. The rate of the reaction was found to be controlled by the diffusion rate of the ferrous-ammonia complex away from the surface. Dissert. Abstr.

N68-32316 National Lending Library for Science and Technology, Boston Spa (England).
CLASSIFICATION OF CARBIDES [O KLASSIFIKATSII KARBIDOV]
G. V. Samsonov Dec. 1967 21 p refs Transl. into ENGLISH from Ukr. Khim. Zh. (Kiev), v. 31, no. 10, 1965 p 1005–1015 (RTS-4233) Available from Natl. Lending Library, Boston Spa, Engl.: £1 5s

A classification of carbides is proposed taking account of physical and chemical properties, electronic and crystal structure of carbide phases, and the periodic classification of the elements. Accordingly, three chemical element groups are specified and their carbides are discussed: the valence s-elements, valence sd-or sfd-elements, and valence sp-elements. The resulting preliminary classification is characterized by: (1) salt-like or ionic carbides formed by nontransition metals having valence s-electrons, (2) covalent-metallic carbides, formed by copper and zinc, having outer s-electrons, (3) covalent carbides formed by elements with outer sp-electrons, (4) metal-like carbides of sd-transition metals, and (5) salt-like covalent-metallic carbides of sdf-transition metals (lathinides and actinides). D.H.B.

N68-32317 National Lending Library for Science and Technology, Boston Spa (England).
POLARISATION OF THE CATHODE IN THE ELECTRODEPOSITION OF CHROMIUM (ILLUSTRATIONS AND CAPTIONS ONLY) [POLYARIZATSIYA KATODA PRI ELEKTROOSAZHDENII KHROMA]
A. T. Vagramyan, D. N. Usachev, and G. I. Chervova May 1968 14 p refs Transl. into ENGLISH from Teoriya i Prak. Elektrolit. Khromir., Akad. Nauk SSSR (Moscow) p 10–26 (RTS-4585) Available from Natl. Lending Library, Boston Spa, Engl.: 10s

During reduction of chromic acid it is shown that reproducible results are possible only when cathode polarization curves are plotted under conditions of constant current strength or constant electrode potential. Separate reactions occurring at the electrode were studied by correlating parts of the polarization curves with the reduction of a hexavalent chromium ion to the trivalent state, evolution of hydrogen, and reduction of chromium to the metal. The presence and absence of sulfuric acid significantly affects the curve form, showing that with increasing concentration, the reduction of chromic acid to metal sharply increases. The investigation also established that a film is formed on the cathode surface which breaks up when the current is switched off. Curves are included reflecting experimental results. D.H.B.

N68-32332 Louisiana State Univ., Baton Rouge.
ELECTRONIC STRUCTURE AND GEOMETRY OF 2-PHENYLNAPHTHALENE DERIVATIVES. A STUDY OF THE ELECTRONIC TRANSITIONS OBSERVED IN ABSORPTION, FLUORESCENCE AND PHOSPHORESCENCE SPECTRA
Homer Edward Holloway (Ph.D. Thesis) 1967 190 p
Available from Univ. Microfilms: HC $8.60/MF $3.00 Order No. 67-13890

The dual emissions previously reported for fluoranthene, 2-phenylnaphthalene and 1,2-benzfluorene have been shown to originate from traces of impurities present in these compounds and are not characteristic of the subsystems of the molecules themselves. Evidence is presented which indicates that even the most weakly coupled 2-phenylnaphthalene configuration cannot exhibit emission properties characteristic of both the benzene and naphthalene subsystems. All the assignments of the energy states observed in 2-phenylnaphthalene are those of the total molecule. SCFMO calculations of these energy states were carried out on the planar 2-phenylnaphthalene system using the methods of Pariser, Parr and Pople. The results of this computation agree well with the experimental data. Fluorescence and phosphorescence quantum yields and phosphorescence lifetime data are presented for all compounds that were studied. Dissert. Abstr.

N68-32334 California Univ., Davis.
STEREOCHEMISTRY OF ASYMMETRIC SILICON: MECHANISTIC STUDIES OF THE SILICON-FLUORINE AND SILICON-HYDROGEN BONDS
Donald Lee Bauman (Ph.D. Thesis) 1967 109 p
Available from Univ. Microfilms: HC $5.40/MF $3.00 Order No. 67-14961

A detailed kinetic study of the alcohol induced racemization of optically active α-naphthylphenylmethylfluorosilane was carried out and several mechanistic models which would lead to racemic product were tested experimentally. Following elimination of those models considered to be inconsistent with the experimental data, a model was proposed which is in good accord with the experimental facts. This model involves the formation of an addition complex between the alcohol and the fluorosilane in which the silicon center has a coordination number greater than four. Several routes were analyzed in which the formation of a penta-covalent species would lead to racemic fluorosilane. The stereochemistry of the hydrogen-halogen exchange reaction between optically active α-naphthylphenylmethylsilane and triphenylmethyl chloride or bromide was also studied. The exchange was observed to occur with extensive racemization when carried out in solvents such as benzene, chloroform, or methylene chloride. The experimental results were rationalized in terms of a mechanism in which electrophilic attack upon the silicon-hydrogen bond by a triphenylmethyl cation is the dominant feature. Dissert. Abstr.

N68-32343 National Lending Library for Science and Technology, Boston Spa (England).
THE HYDRATION KINETICS OF BINDING MATERIALS [KINETIKA GIDRATATSII VYAZHUSHCHIKH VESHCHESTV]
A. F. Polak and L. G. Karlova [1967] 18 p refs Transl. into ENGLISH from Tr., Bashkirsk. Nauchn.-Issled. Inst. po Stroit. (Moscow), no. 5, 1965 p 374–386
(RTS-4230) Available from Natl. Lending Library, Boston Spa, Engl.

A critical examination is made of 12 empirical and theoretical formulae describing the hydration kinetics of binding substances. A universal method is proposed for solving the differential equations of hydration kinetics, and this technique is explained in detail. By analyzing an experimental curve, calculations were made of the parameters determining the rate of hydration of alpha-semihydrated gypsum. The results agreed well with those obtained by analyzing elementary processes. C.T.C.

N68-32361 National Lending Library for Science and Technology, Boston Spa (England).
HYDROGEN BOND AND TEMPERATURE DEPENDENCE OF KERR'S CONSTANT OF LIQUIDS [VODNEVII ZV'YAZOK I TEMPERATURNA ZALEZHNIST' STALOI KERRA RIDIN]
A. E. Lutskii et al Nov. 1967 7 p refs Transl. into ENGLISH from Ukr. Fiz. Zh. (Kiev), v. 12, no. 2, 1967 p 271–274
(RTS-4225) Available from Natl. Lending Library, Boston Spa, Engl.: 10s

The temperature dependence of Kerr's constant was measured for nitrobenzene, dimethyl aniline, NN-dimethyl formamide, phenol, aniline, N-methyl acetamide, and N-ethyl benzamide in the range from 20° to 80°C. It was assumed that the usual temperature effect may be overlayed in liquids in which complexes of molecules are linked by hydrogen bonds. By the breakdown of these complexes and an increase of microparticles with temperature, the Kerr constant may differ in magnitude and possibly in sign. The results of these measurements indicate that liquids with complexes of molecules as kinetic units act in accord with the fact that Kerr's constant for complexes is negative for phenol and aniline solutions, but positive and large for secondary amines. In summary, the nature of temperature dependence of Kerr's constant is changed substantially in liquids with hydrogen bonded complexes. D.H.B.

N68-32366# Naval Research Lab., Washington, D. C. Electrochemistry Branch.
CRYSTALLOGRAPHIC CHANGES DURING OXIDATION (CHARGING) OF THE SILVER ELECTRODE. PART 2: OXIDATION FOLLOWING FIVE CHARGE-DISCHARGE CYCLES AT A LOW RATE Interim Report
C. P. Wales and A. C. Simon 13 May 1968 24 p refs
(NRL-6707; AD-671771)

The microstructures and morphology observed during the charge of a sintered Ag electrode that had received five slow charge-discharge cycles in 35% KOH solution differed considerably from those observed during the initial charge. The Ag particles in the discharge electrode with five prior cycles were larger and much more uniform in size than those in the unused electrode. The size of the voids between particles had also increased with cycling. After the electrodes were charged, the aggregates of AgO crystals were smaller in the cycled electrode and more widely spaced. Very little difference was noted in the forms of either Ag2O or AgO crystals in the two cases, but considerably less of either oxide was formed during the sixth charge. The electrode capacity had declined as a result of the gradual change in structure. Author (TAB)

N68-32367 National Lending Library of Science and Technology, Boston Spa (England).
DEPENDENCE OF KERR'S CONSTANT OF SOME SUBSTITUTED PHENOLS AND ANISOLES ON CONCENTRATION AND TEMPERATURE [KONTSENTRATSIINA I TEMPERATURNA ZALEZHNOSTI STALOI KERRA DAYAKIKH ZAMISHCHENIKH FENOLU TA ANIZOLU]
A. E. Lutskii and V. T. Chalyi Oct. 1967 6 p refs Transl. into ENGLISH from Ukr. Fiz. Zh. (Kiev), v. 12, no. 2, 1967 p 281–284
(RTS-4226) Available from Natl. Lending Library, Boston Spa, Engl.: 10s

Data for concentration and temperature dependence of Kerr's constant of some substituted phenols confirm the community of dependences, characterizing the influence of complexing on Kerr's effect. Author

N68-32395 Johns Hopkins Univ., Baltimore, Md.
A STRIPPING THEORY MODEL OF ION-MOLECULE REACTIONS
Barbara Yoder Howard (Ph.D. Thesis) 1967 118 p
Available from Univ. Microfilms: HC $5.80/MF $3.00 Order No. 67-13803

The stripping theory model for ion–molecule reactions is based upon a nuclear stripping or direct reaction theory. A cross section expression is developed by a wave-vector treatment and by

a more rigorous method involving Green's functions. A preliminary discussion of possible calculations involving a harmonic oscillator model is also included. Dissert. Abstr.

N68-32396 Iowa State Univ. of Science and Technology, Ames.
THE CRYSTAL STRUCTURE DETERMINATIONS OF $Cu_5Cl_{10}(C_3H_7OH)_2$, $DyCl_3 \cdot 6H_2O$ AND $Ag(P(OCH_2)_3CCH_3)_4ClO_4$
Josef Vendal Ugro, Jr. (Ph.D. Thesis) 1967 86 p
Available from Univ. Microfilms: HC $4.60/MF $3.00 Order No. 67-13008

The results of single crystal X-ray diffraction studies on $Cu_5Cl_{10}(C_3H_7OH)_2$, $DyCl_3 \cdot 6H_2O$ and $Ag(P(OCH_2)_3CCH_3)_4ClO_4$ are reported. The compound $Cu_5Cl_{10}(C_3H_7OH)_2$ crystallizes the monoclinic system with space group $P2_1/c$, lattice constants a = 10.244 ± .007Å, b = 6.025 ± .008A, c = 20.41 ± 015Å, β = 115.48 ± .03° and z = 2. The compound $DyCl_3 \odot 6H_2O$ crystallizes in the monoclinic system with space group P2/n, lattice constants a = 7.868 ± .003Å, b = 6.491 ± .003Å, c = 9.596 ± .004Å, β = 93.69 ± 02° and z = 2. The compound $Ag(P(OCH_2)_3CCH_3)_4ClO_4$ crystallizes in the tetragonal system with space group $I4_1/a$, lattice constants a = b = 11.757 ± .003Å, c = 23.624 ± 006Å and z = 4. Dissert. Abstr.

N68-32442 National Lending Library for Science and Technology, Boston Spa (England).
THE HEAT OF MIXING OF SOLUTIONS OF ETHYL ALCOHOL-WATER [TEPLOTA CMESHENIYA RASTVOROV ETANOL-VODA]
Ya. V. Zel'tser Dec. 1967 9 p refs Transl. into ENGLISH from Fermentanaya i Spirt. Prom. (USSR), v. 32, no. 4, 1966 p 11–14
(RTS-4291) Available from Natl. Lending Library, Boston Spa, Engl.: 10s

Alcohol content, heat of mixing, and contraction in the formation of water-ethyl alcohol solutions indicate that change in volume is not proportional to heating effect. A maximum heating occurs in the formation of a 30% solution, and maximum contraction with a 50% solution. A method is presented for computing heat of mixing for water-alcohol solutions of any content; and results are presented for data obtained at 20°C. For these calculations it was assumed that degree of dissociation of hydrates was small. M.W.R

N68-32446 National Lending Library for Science and Technology, Boston Spa (England).
THE CATALYTIC ACTIVITY OF SOME SULPHIDES AND OXIDES WITH REGARD TO SURFACE RECOMBINATION OF ATOMIC HYDROGEN
V. V. Styrov [1968] 21 p refs Transl. into ENGLISH from Kinetika i Kataliz (Moscow), v. 9, no. 1, 1968 p 124–129 In RUSSIAN and ENGLISH
(M-7206) Available from Natl. Lending Library, Boston Spa, Engl.

The recombination coefficients of hydrogen atoms in zinc sulfide and a number of metal oxides were measured in the temperature range 300°–400°K. Recombination at these temperatures is shown to follow first order kinetics. It is suggested that surface defects are responsible for the observed temperature dependence of the recombination coefficient. Contaminants in the solid are shown to affect the activation energy of the recombination of atoms into a molecule on the surface. Author

N68-32472 National Lending Library for Science and Technology, Boston Spa (England).
APPROXIMATE EXPRESSION OF THE TEMPERATURE DEPENDENCE OF THE MASS-TRANSPORT COEFFICIENTS OF GASES BY MEANS OF Ā POWER LAW [DIE ANNAEHERUND DER TEMPERATURAB HAENGIGKEIT DER TRANSPORTKOEFFIZIENTEN VON GASEN DURCH EINEN POTENZANSATZ]
R. Mueller 21 May 1968 11 p refs Transl. into ENGLISH from Chem.-Ingr.-Tech. (Weinheim/Bergstrasse), v. 40, no. 7, 10 Apr. 1968 p 344–349
(SMRE-TRANS-5610) Available from Natl. Lending Library, Boston Spa Engl.

The self-diffusion coefficients, the viscosity, and the heat conductivity of several gases were calculated according to the formulas given by Hirschfelder, as were the binary diffusion coefficients of pairs of gases between 0°C and 1000°C, and the results were approximated by means of a power relationship. The parameters obtained by this method are given and the errors involved are discussed. Author

N68-32473 National Lending Library for Science and Technology, Boston Spa (England).
STUDY OF THE EFFECT OF PIGMENTS AND FILLERS MODIFIED BY THE RADIATION POLIMERIZATION METHOD ON STRUCTURE FORMATION IN POLYMERS [ISSLEDOVANIE VLIYANIYA PIGMENTOV I NATOLNITELEI, MODIFITSIROVANNYKH METODOM RADIATSIONNOI POLIMERIZATSII, NA STRUKTURGOBRAZOVANIE V POLIMERAKH]
G. S. Blyskosh, L. P. Yanova, A. B. Taubman, G. G. Ryabchikova, and A. A. Yakubovich Apr. 1968 8 p refs Transl. into ENGLISH from Lakokrasochnye Materialy i ikh Primenanie (Leningrad), no. 4, 1967 p 36–38
(RTS-4458) Available from Natl. Lending Library, Boston Spa Eng.: 7s 6d

A study was made of the effect of radiation grafting of polymers to the surface of dispersed mineral pigments and fillers on their structure formation in model suspensions. It was found that the quantity of grafted polystyrene and polymethyl methacrylate is proportional to the irradiation dose and is dependent upon the properties of the base layer. Modification changes the structural and mechanical properties of suspensions at a relatively low degree of coating of the solid phase with polymer. Author

N68-32481 Purdue Univ., Lafayette, Ind.
A SPECTROSCOPIC INVESTIGATION OF GROUP 5 DONOR STATES IN GERMANIUM
John Henry Reuszer (Ph.D. Thesis) 1967 152 p
Available from Univ. Microfilms: HC $7.20/MF $3.00 Order No. 67-16702

A study of the optical excitation spectra of Group V donors in germanium yields direct information about the energy states of these impurities. It is known that the ground states of such impurities exhibit greater complexity than that predicted by the effective mass theory. Corrections to the effective mass potential have the site symmetry of the impurity and, when applied, split the four-fold degenerate effective mass ground state into a one-fold and a three-fold degenerate state. Observations of this type have been made at temperatures near that of liquid helium using a far infrared grating spectrometer equipped with an optical cryostat. The determination of which lines in the two series have common excited states is made by a comparison of the line spacings in one series with those in the other series. The ground state splittings determined in this way are 2.83 meV, 4.23 meV, 2.87 meV, and 0.32 meV for phosphorus, arsenic, bismuth, and antimony impurities, respectively. Dissert. Abstr.

N68-32483 Columbia Univ., New York.
MOLECULAR DYNAMICS OF HYDROGENOUS COMPOUNDS FROM INTERACTIONS WITH SUB-THERMAL NEUTRONS

Pak Sang Leung (Ph.D. Thesis) 1967 185 p
Available from Univ. Microfilms: HC $8.40/MF $3.00 Order No. 67-14066

Transmission measurements with subthermal neutrons obtained from a crystal spectrometer at the Brookhaven Graphite Reactor have been made on a series of hydrogenous compounds at temperatures varying from 100°k to 500°K and at neutron energies from 0.0006eV to 2eV. Inelastic scattering spectra were also obtained for several of the compounds. The following substances were investigated: NH_4F, NH_4Cl, NH_4Br, NH_4I, $(NH_4)_2SO_4$, $(NH_4)_2Cr_2O_7$, NH_4ClO_4, hexamethyl benzene, durene, d-camphor, ethylene bromide, water, $K_4Fe(CN)_6 \cdot 3H_2O$, $CuSO_4 \cdot 5H_2O$, $ZnSO_4 \cdot 7H_2O$, polyethylene, polypropylene, polymethyl methacrylate, silicone polymers and natural rubber. The variations of the cross sections per hydrogen atom with temperature for the various compounds have been calculated from the transmission data. The results, along with theoretical calculations of the cross sections using the harmonic oscillator approximation, have been used to study the freedom of molecular motions. Dissert. Abstr.

N68-32492 National Lending Library for Science and Technology, Boston Spa (England).
VISCOSIMETRIC TITRATION OF NON-AQUEOUS SOLUTIONS OF METHACRYLIC ACID COPOLYMERS [VISKOZIMETRICHESKOE TITROVANIE NEVODNYKH RASTVOROV SOPOLIMEROV METAKRILOVOI KISLOTY]
V. P. Barabanov and A. I. Kurmaeva Feb. 1968 7 p refs Transl. into ENGLISH from Izv. Vyssh. Ucheb. Zaved., Khim. i Khim. Tekhnol. (Moscow), v. 9, no. 4, 1966 p 645-648
(RTS-4378) Available from Natl. Lending Library, Boston Spa, Engl.: 10s

When non-aqueous solutions of methyl methacrylate – methacrylic acid copolymers were titrated with hydroxides of alkali metals, we observed a sudden rise in viscosity, due to increased intermolecular electrostatic interaction. The nature of the change in viscosity depends on the density of ionogenic groups in the macromolecular chain, the ionising capacity of the solvent, and the nature of the metal ion in the titrant. The viscous effect of titration increases in the order Li–Na–K. We determined the effect of alkali on the concentration dependence of viscosity number for solutions of copolymers of a poly-electrolytic nature. This was due to the destruction of hydrogen bonds and a chemical change in the polymer chain. Author

N68-32500 National Lending Library for Science and Technology, Boston Spa (England).
THE HYDROTHERMAL SYNTHESIS OF CHRYSOTILE [GIDROTERMALNYI SINTEZ KHRIZOTILA]
N. J. Nesterchuk, T. A. Makarova, and A. D. Fedoseev Dec. 1967 7 p refs Transl. into ENGLISH from Zap. Vses. Mineralog. Obshchestva (Moscow), v. 95, no. 1, 1966 p 75–79
(RTS-4305) Available from Natl. Lending Library, Boston Spa, Engl.: 10s

Reported is the synthesis of pure serpentine from magnesium oxide (or hydroxide) and silicon gel at 350°C, 900 atm pressure and median pH of 7 to 9. Microscopic, thermographic, chemical, and electron microscopic analyses of the obtained product chrysotile established good analogy with natural chrysotile. Decomposition at high temperatures and in the presence of air gave amorphous silicon over forsterite reaction. G. G.

N68-32507 National Lending Library for Science and Technology, Boston Spa (England).
ON THE RELATION BETWEEN THE FORM OF THE AMPHIBOLE CRYSTALS AND THEIR CHEMICAL COMPOSITION [O SVYEZI OBLIKA KRISTALLOV AMFIBOLOV Z ICH KHIMICHESKIM SOSTOVOM]
B. V. Chesnokov Dec. 1967 6 p refs Transl. into ENGLISH from Zap. Vses. Mineralog. Obshchestva (Moscow), v. 95, no. 4, 1966 p 543-545
(RTS-4309) Available from Natl. Lending Library, Boston Spa, Engl.: 7s 6d

Structural differences in amphibole crystals are expressed by dimensional variations in the ratios of (010) and (001). Statistical calculations on main chemical components in amphiboles from different rocks indicated that high temperature amphiboles featured a much more complex composition and more isometric crystals than low temperature amphiboles; the more complex the chemical composition of the amphiboles was the more isometrical was their crystal structure. G.G.

N68-32508 National Lending Library for Science and Technology, Boston Spa (England).
THE EFFECT OF THE VACUUM CALCINATION TEMPERATURE ON THE GRAIN AND PARTICLE SIZE OF RUTILE [VLIYANIE TEMPERATURY PROKALIVANIYA V. VAKUUME NA TEKSTURU I. DISPERSNOST' RUTILA]
A. A. Isirikyan and I. A. Kazmenko Apr. 1968 8 p refs Transl. into ENGLISH from Lakokrasochnye Materialy i ikh Primenenie (Leningrad), v. 4, 1967 p 28–30
(RTS-4457) Available from Natl. Lending Library, Boston Spa, Engl. 7s 6d

Acid and thermal vapor treatment effects on hydrolytic titanium oxide were studied by observing the grain and particle size after nitrogen adsorption at 195°C and after benzene treatment in a vacuum at 25° to 800°C. Adsorption isotherms of nitrogen and benzene showed a dependency between weight loss and calcination temperatures. Evacuation of rutile at 25 to 400°C increased the specific area slightly; at higher temperatures a sharp decrease was noted and at 800° the rutile area became equal to the value of the area for common pigmented rutile samples. G.G.

N68-32509 National Lending Library for Science and Technology, Boston Spa (England).
A STUDY OF THE KINETICS OF DECOMPOSITION OF FLOATED KORATAU PHOSPHORITE BY A SOLUTION OF POTASSIUM NITRATE IN NITRIC ACID [ISSLEDOVANIYE KINETIKI RAZLOZHENIYA FLOTIROVANNOVO FOSFORITA KARATAU AZOTNOKISLOTNYM RASTVOROM NITRATA KALIYA]
A. M. Amirova and M. N. Nabiev Feb. 1968 6 p refs Transl. into ENGLISH from Uzbeksk. Khim. Zh. (USSR), v. 5, 1965 p 5–8
(RTS-4395) Available from Natl. Lending Library, Boston SPA, Engl. 10s

The rate of phosphorite decompesition in a solution of potassium nitrate and nitric acid was analyzed by observing the rate of hydrogen ion diffusion into the surface of the solid. It was shown that the values of the reaction rate constants gradually diminished with time. Calculated reaction rate constants at 40°, 60°, and 80°C and the activation energy of the process established the dependence of the reaction rate constant on the temperature. An empirical equation was proposed for rate constant calculations at varying temperatures. G.G.

N68-32522# McGill Univ., Montreal (Quebec). Dept. of Chemistry.
DEHYDRATION KINETICS AND GLASS TRANSITION OF POLY(ACRYLIC ACID)
A. Eisenberg, T. Yokoyama, and Emma Sambalido Jun. 1968 11 p refs
(Contract N00014-68-C-0237)
(TR-17; AD-671849)

The kinetics of dehydration and decarboxylation as well as the glass transition temperature as a function of anhydride content were measured for poly(acrylic acid). It was found that the

glass transition of PAA is of the order of 103C and increases with increasing anhydride content, reaching an extrapolated value of 140C for the pure linear anhydride. Anhydride formation is first order reaction, as is also decarboxylation, the latter being much slower than the former. Anhydride formation occurs primarily by an intramolecular process.
Author (TAB)

N68-32529 Akron Univ., Ohio.
CRYSTALLIZATION OF TRANS-1,4-POLYISOPRENE COPOLYMERS
Alfred Ellis Fields (Ph.D. Thesis) 1967 133 p
Available from Univ. Microfilms: HC $6.40/MF $3.00 Order No. 67-13145

An experimental study has been made of the effect of copolymeric *cis* units on the rates of spherulite growth and overall crystallization rates of trans 1, 4 polyisoprene. The isomerized samples were prepared by reacting thiobenzoic acid with trans 1, 4 polyisoprene at 140°C. The pure and isomerized materials were examined microscopically and dilatometrically. It was found that trans 1, 4 polyisoprene is composed of two crystal forms, high and low melting, having melting temperatures of 62.5 and 53.4°C, respectively. These are average values determined microscopically. The spherulite growth and nucleation rates were found to be dependent on the degree of supercooling and increased with a decrease in temperature.
Dissert. Abstr.

N68-32543 National Lending Library for Science and Technology, Boston Spa (England).
INVESTIGATIONS OF THE CRYSTALLIZATION CONDITIONS OF FIBROUS AMPHIBOLE DURING HYDROTHERMAL SYNTHESIS [IZUCHENIE USLOVII KRISTALLIZATSII VOLOKNISTOGO AMFIBOLA PRI GIDROTERMAL'NOM SINTEZE]
D. P. Sipovskii, T. A. Makarova, and A. D. Fedoseev Dec. 1967 12 p refs Transl. into ENGLISH from Zap. Vses. Mineral. Obshchestva (USSR), v. 95 no. 4, 1966 p 436–441
(RTS-4308) Available from Natl. Lending Library, Boston Spa, Engl.: 15s

Some of the factors that affect the recrystallization of fibrous amphiboles under hydrothermal conditions were investigated. The four characteristic zones that occur during synthesis under hydrothermal conditions consist of (1) short amphibole fibers gathered into aggregates of "cat-ear" shape, (2) fiber bundles of various dimensions in the form of sheaves as well as lumps of cat ears, (3) long fibers that are more elastic and dense in which the spherulitic nature of fiber growth is detected, and (4) amphibole fibers overwhelmed by impurities in the form of nuclei and microcrystals of magnesium hydrosilicate, crystals of forsterite, and flakes of serpentine. Effect of the size of $Mg(OH)_2$ particles, the excess of silica in the mixture, effect of dilution and L:S ratio, and time of reaction and temperature conditions are discussed. Effect of the pH of the medium on the crystallization of amphibole is also considered.
M.W.R.

N68-32544 Michigan State Univ., East Lansing.
DETERMINATION OF A_0 FOR AXIALLY SYMMETRIC MOLECULES
Thomas Leslie Barnett (Ph.D. Thesis) 1967 174 p
Available from Univ. Microfilms: HC $8.00/MF $3.00 Order No. 67-14471

A new method is developed for determination of accurate values of the molecular constant A_0 for axially symmetric molecules by simultaneously analyzing a degenerate fundamental band and its first overtone. In particular, the method is developed for a simultaneous fit of the ν_4 and $2\nu_4$ bands of a methyl halide. [$A_0 = h/(8\pi^2 c I_0 A)$, where $I_0 A$ is principal moment of inertia of the molecule about its axis of symmetry in the ground vibrational state. Accurate values of $I_0 A$ are necessary to determine the structures of these molecules.] This method of determining A_0 has been successfully applied through least squares computer analyses to high resolution spectra of the methyl halides and similar molecules. The excellent value of $A_0 = 5.1291 \pm 0.0009$ cm^{-1} obtained for methyl bromide seems to clearly demonstrate the superiority of this method over previous methods of determining A_0.
Dissert. Abstr.

N68-32553 National Lending Library for Science and Technology, Boston Spa (England).
ION EXCHANGERS; INDUSTRIAL ION EXCHANGE MATERIALS
A. B. Pashkov, K. M. Salkadze, and B. Ia. Kelman Jan. 1968 17 p Transl. into ENGLISH of the book "Ionity; Ionity Vypuskaemye Promyshlennost'yu" USSR, Gos. Kom. Khim. Prom., 1965 p 1–15
(RTS-4339) Available from Natl. Lending Library, Boston Spa, Engl.: 35s

Appearance and other characteristics of anion and cation exchangers used as industrial materials are reviewed. Included are strongly acidic cation exchangers designated as ku-l, ku-lg, ku-2-8, and ku-2-8chs; and weakly acidic polymerized cation exchanger kb-4p-2. Also reported are properties of strongly basic polycondensation resin av-16g, av-16gs, av-17-8, av-17-8, av-17-8chs; weakly basic anion exchanger eds-10p separately and in hydroxyl form; weakly basic semicondensation resins an-2fu; weakly basic polycondensation anion materials an-1, an-8-6, an-31; and weakly basic polymerization-type resin anion exchangers especially developed for industrial use and designated as an-23, an-25, av-20, and av-23.
M.W.R.

N68-32554 National Lending Library for Science and Technology, Boston Spa (England).
DETERMINATION OF THE CONSTANT OF REACTION VELOCITY OF THE ATOM H WITH THE MOLECULE C_2H_5OH [OPREDILYENIE KONSTANTY SKOROSTI REAKTSII ATOMA H S MOLEKULOI C_2H_5OH]
K. T. Oganesyan, A. B. Nalbandyan, and N. I. Parsamyan Mar. 1968 5 p refs Transl. into ENGLISH from Dokl. Akad. Nauk Arm. SSR (Erevan), v. 40, no. 3, 1965 p 159–163
(RTS-4424) Available from Natl. Lending Library, Boston Spa, Engl.: 12s 6d

The constant for the reaction velocity of the hydrogen atom plus the ethylalcohol molecule was obtained by measuring the lower limits for the ignition of a stoichiometric mixture of hydrogen and oxygen containing different amounts of ethylalcohol between the temperatures of 570 and 690°C. The transfer vessel was thermostatted to preserve the constant values of the transfer coefficients. The assumed small activity of the radical C_2H_4OH formed during the reaction is considered reaffirmed by this investigation.
M.W.R.

N68-32570 National Lending Library for Science and Technology, Boston Spa (England).
MOLECULAR LIGHT SCATTERING IN LIQUID n-PARAFFINS AND n-ALCOHOLS AND ITS RELATION TO OTHER PHYSICAL PROPERTIES [MOLEKULYARNE ROZSIYANNYA SVITLA V RIDKIKH n-PARAFINAKH I n-SPIRTAKH TA IOVO ZV'YAZOK Z INSHIMI FIZICHNIMI VLASTIVOSTYAMI]
G. P. Roshchina and E. D. Ishchenko Feb. 1968 9 p refs Transl. into ENGLISH from Ukr. Fiz. Zh. (Kiev), v. 12, no. 5, 1967 p 852–857
(RTS-4364) Available from Natl. Lending Library, Boston Spa, Engl.: 15s

The authors investigated intensity of dense and anisotropic light scattering in liquid n-paraffins (nonane, undecane, dodecane, tridecane, tetradecane, pentadecane, hexadecane) and n-alcohols

(amyl, heptyl, nonyl, decyl) over a temperature range from 20 to 120°C. It is established that the polytherms of intensity of dense scattering for paraffins arrange in the same order as polytherms of compressibility. It is shown that a temperature dependence of dense scattering intensity for alcohols and paraffins is well described by an empirical relationship. Author

N68-32574 Washington Univ., Seattle.
UNIMOLECULAR REACTION KINETICS AND INTERMOLECULAR ENERGY TRANSFER
Dwight Carden Tardy (Ph.D. Thesis) 1967 255 p
Available from Univ. Microfilms: HC $11.50/MF $3.30 Order No. 67-14226

A general formulation of the rates of competitive unimolecular reactions is given, and various relationships between the rates and energetics of competing processes are described. The variation of the collisional efficiency of several inert gases has been studied for a homologous series of alkyl-2 radicals. The deactivators N_1, N_2, CH_4, and CF_4 were used in conjunction with butyl-2, pentyl-2, hexyl-2, and oxtyl-2 radicals excited by chemical activation. The findings were considered. To assess further the operational meaning of efficiency, collisional activation†deactivation efficiencies, β, for thermal unimolecular reactions in the fall-off region have been computed on a stochastic model, with use of an interation procedure. Dissert. Abstr.

N68-32577 National Lending Library for Science and Technology, Boston Spa (England).
THE PROBLEM OF THE DECOMPOSITION OF ILMENITE CONCENTRATE WITH SULPHURIC ACID [K VOPROSU O RAZLOZHENII IL'MENITOVOGO KONTSENTRATA SERNOI KISLOTOI]
A. M. Bobrova, E. V. Balukova, and V. B. Savel'eva Feb. 1968 11 p refs Transl. into English from Lakokrasochnye Materialy i Ikh Primenenie (Leningrad), no. 6, 1966 p 11–14
(RTS-4362) Available from Natl. Lending Library, Boston Spa., Engl.: 10s

The basic decomposition reaction is investigated, and the reaction products obtained ranged from moist clotted to hard monolithic types. Details are given of the procedures and of the composition of the concentrate. The duration of the reaction was determined for concentrations of acid between 83% and 92% and at temperatures ranging from 80° to 140°C. The duration of the reaction was found to be longer for coarsely ground ilmenite than for finely ground concentrate, and the degree of sufation was generally higher. The possibility of discharge of the reaction mass was determined to be connected mainly with the final concentration of acid and the initial temperature of the mixture. N.E.N.

N68-32586 Western Reserve Univ., Cleveland, Ohio.
ELECTROCHEMICAL PROCESSES ON NICKEL OXIDE
Daniel Charles Yohe (Ph.D. Thesis) 1967 195 p
Available from Univ. Microfilms: HC $8.80/MF $3.00 Order No. 67-15560

The objective of this thesis research has been to study the electrochemical properties of compound semiconductors. Anhydrous NiO has been chosen because 1) it affords an opportunity to examine charge transfer between ionic solution phase species and a semiconductor with rather localized carriers corresponding to controlled valency states, 2) extensive work has been reported in the literature for this oxide in conjunction with gas-solid catalysis studies and 3) this oxide is of importance in fuel cell and corrosion studies. The principal portion of the present research has been directed to the study of the intrinsic electrochemical properties of the NiO-solution interface and the behavior of various electrochemical couples at this interface. The former has involved linear sweep voltammetry measurements complemented by a.c. impedance and dissolution studies. The latter has involved the study of various couples including some which are known to require strong interaction with the interface and others where such is believed not to be necessary. Dissert Abstr.

N68-32593# IIT Research Inst., Chicago, Ill.
ADVANCED OXIDIZER CHEMISTRY Technical Summary Report, 1 Jan.–31 Mar. 1968
Irvine J. Solomon 14 Jun. 1968 27 p refs
(Contract F44620-68-C-0039)
(IITRI-C6135-1; AFOSR-68-1571; AD-671974)

Perfluoropropene and O2F2 reacted at -183C in chlorotrifluoromethane to give two new compounds, perfluoro-i-propyl fluoroperoxide, (CF2)2CFOOF and perfluoro-n-propyl fluoroperoxide CF3CF2CF2OOF. The primary reaction of both O2F2 and and O4F2 with SO2 are similar; that is, simple fluorination results, however, O4F2 appears to be a much better source of OOF than O2F2. The structure and properties of O2ClF3 are being studied. The mechanism of the reaction of COF2 and OF2 to give CF3OOOCF3 is being studied by means of oxygen-17 tracer techniques. Author (TAB)

N68-32606 National Lending Library for Science and Technology, Boston Spa (England).
PURIFICATION OF HYDROCARBONS AS SOLVENTS FOR ULTRA-VIOLET SPECTROSCOPY
Gerhard Hesse and Hermann Schildknecht 18 Jun. 1968 7 p refs Transl. into ENGLISH from Angew. Chem. (Weinheim/Bergstrasse), v. 67, no. 23, 7 Dec. 1955 p 737–739 *Its* Transl. No. 988
Available from Natl. Lending Library, Boston Spa, Engl.

Very pure hexane and cyclohexane have proved themselves as solvents for U.V. spectroscopy. Precleaning with H_2SO_4 and subsequent filtration through a suitable aluminium oxide column gave efficient purification. It was particularly easy to obtain pure preparations from technically pure cyclohexane with the aid of successive filtration through silica gel and aluminium oxide. Author

N68-32607 National Lending Library for Science and Technology, Boston Spa (England).
SPECTROPHOTOMETRIC DETERMINATION OF NICKEL, COBALT AND CHROMIUM IN STEELS. 1: ESTIMATION OF SYSTEMATIC ERRORS ARISING FROM UNDETERMINED COMPOUNDS
N. P. Komar' and L. S. Palagina 10 Oct. 1967 17 p refs Transl. into ENGLISH from Zh. Analit. Khim. (Moscow), v. 21, no. 11, 1966 p 1324–1332 In RUSSIAN and ENGLISH *Its* Transl. 67/243
Available from Natl. Lending Library, Boston Spa, Engl.

An evaluation is made of systematic errors in the spectrophotometric determination of Ni, Co and Cr, on the basis of the coloring of ions in a multi-component system (steel). Measurements were made of the molar extinction coefficients of Fe^{3+}, Cu^{2+}, Al^{3+}, Mn^{2+}, and VO^{2+} sulphato–aquo complexes. Using these coefficients, the optical density due to these components was calculated for their maximum concentration in a 2 g steel sample. It was found that only absorption due to iron and vanadium cannot be neglected. Author

N68-32618# Manitoba Univ., Winnipeg. Dept. of Chemistry.
SURFACE STABILIZED FREE RADICALS Final Report, 1 May 1964–31 Jan. 1968
H. D. Gesser 31 May 1968 18 p refs
(Grant AF-AFOSR-642-66)
(AFOSR-68-1313; AD-671928)

Methyl radicals, formed by the photolysis of CH3I at 77K were stabilized on the porous glass indefinitely at this temperature

and decayed with first order kinetics at higher temperatures with an activation energy of about 2 kcal/mole. The decay showed a cascade effect indicating the presence of a multi site surface. High resolution ESR spectra gave a further splitting of the hyperfine lines which were interpreted in terms of a B11-CH3 interaction. This was subsequently shown to be probably due to water on the surface and the degassing condition since a deuterated surface almost eliminated the effect. Line width measurement for CH3 led to a tumbling frequency which is of the order of 10 to the 8th power/sec and an activation energy for tumbling of about 300 cal/mole for CH3 on the surface. The photolysis of CH3OH (and its deuterated isomers) on porous glass was also examined and interpreted in terms of the I.R. absorption studies. Comparable studies were also made with a TiO2 impregnated surface. The stabilization of hydrogen atoms was also examined and was similar in behaviour to CH3 except that the decay was 2nd order and the H atom showed definite decay at 77K. Author (TAB)

N68-32657 National Lending Library for Science and Technology, Boston Spa (England).
BENZENE RADIOLYSIS PRODUCTS AS ACCEPTORS OF EXCITATION [PRODUKTY RADIOLIZA BENZOLA KAK AKTSEPTORY VOZBUZHDENIYA]
M. N. Guraki and V. P. Deryunova Dec. 1967 8 p refs Transl. into ENGLISH from Dokl. Akad. Nauk Uz. SSR, no. 24, 1967 p 22-25
(RTS-4312) Available from Natl. Lending Library, Boston Spa, Engl.: 10s

The manner in which products of a low concentration (10-4 to 10-3 mol/l) deactivate benzene molecules at a lower singlet level of excitation was studied. A spectro-luminescence analysis of benzene was made. The condition of complete absorption of the excitant light was observed, and therefore excitation and observation were carried out at the same level of the container. The extinction of photoluminescence takes place evidently as a result of the formation of radiolysis products. The extinction coefficients of luminescence of aromatic compounds by quenchers of various kinds agree well with those previously published. Author

N68-32665 National Lending Library for Science and Technology, Boston Spa (England).
THERMAL DECOMPOSITION OF URANIUM OXIDES IN VACUUM [TERMICHESKOE RAZLOZHENIE OKISLOV URANA V VAKUUME]
I. I. Kozhina, L. V. Shiryaeva, and Ya. M. Tomachev Jun. 1968 13 p refs Transl. into ENGLISH from Vestn. Leningr. Univ. (Leningrad), no. 10, 1967 p 133-140
(RTS-4586) Available from Natl. Lending Library, Boston Spa, Engl.: 20s

Comparative studies on the nature of thermal dissociation of uranium oxides upon vacuum heating at different temperatures, and the extent of the region of homogenity in the rhombic phase, are reported. Results indicate that: (1) the lower and higher oxides of uranium decompose in vacuum even at relatively low temperatures, thus at 300 to 500°C the decomposition product is $UO_{2.660}$-$UO_{2.650}$; (2) the decomposition of U_3O_8 proceeds in two stages with different velocities and at 600 to 900°C the apparent energy of activation of both processes is the same (22kcal/mol); (3) in the first stage U_3O_8 decomposes to $UO_{2.635}$ and in the second stage $UO_{2.635}$ decomposes to $UO_{2.605}$; (4) the rhombic phase obtained by decomposition of U_3O_8 is in the range of compositions $UO_{2.662}$ to $UO_{2.605}$; (5) uranium oxides also decompose in sealed evacuated capillary tubes; and (6) theoretical calculations confirmed experimental evidence for the diffusion controlled character of the second stage of decomposition at 700°C to 900°C, the activation energy of this state was 45 + 5 kcal/mol. S.C.W.

N68-32670 National Lending Library for Science and Technology, Boston Spa (England).
DETERMINATION OF THE QUANTITY OF ETHYLENE OXIDE IN OXYETHYLATED PRODUCTS [OPREDELENIE SODERZHANIA OKISI ETILENA V OKSIETILIROVANNIKH PRODUKTAKH]
A. A. Petrov Nov. 1967 6 p refs Transl. into ENGLISH from Maziozhir Prom. (USSR), v. 33, no. 4, 1967 p 39-40
(RTS-4267) Available from Natl. Lending Library, Boston Spa, Engl.: 5s

Described are methods used in determining the quantity of ethylene oxide in oxyethylated products which are based on the cleavage reaction of hydriodic acid with oxyethylene compounds. In this reaction, for each reacting oxyethylene group two atoms of iodine are liberated, the quantity being easily determined by titration with a solution of sodium thiosulphate. Results of analyses of products with a known content of glycol groups are included which demonstrate that the method of hydriodic acid reduction determines not less than 99.0 to 99.9% of the ethylene oxide in polyglycolic ethers. S.C.W.

N68-32682# Sandia Corp., Albuquerque, N. Mex.
A BIBLIOGRAPHY ON THE DETERMINATION OF NITROGEN BY ACTIVATION ANALYSIS
Nelson D. Stalnaker, Milton Kahn, and B. T. Kenna Apr. 1968 20 p refs
(SC-R-68-1723) CFSTI: HC $3.00/MF $0.65

This bibliography on the determination of nitrogen by activation analysis contains 130 references to articles, bibliographies, books, reviews, and reports. The references were obtained from Nuclear Science Abstracts, Chemical Abstracts, and Chemical Titles for the period January 1951 through June 1967, inclusive. Author (NSA)

N68-32685# Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.
ALPHA RADIOLYSIS OF PLUTONIUM (4) - NITRIC ACID SOLUTIONS
J. C. Sheppard May 1968 21 p refs
(Contract AT(45-1)-1830)
(BNWL-751) CFSTI: HC $3.00/MF $0.65

Some of the factors influencing the radiolytic generation of gases from plutonium-nitric acid solutions were investigated. It was found that small but significant amounts of oxygen and hydrogen are generated. The "G" values decrease with increasing nitric acid concentration, are independent of the temperature, and are slightly affected by the atmosphere over the solution. Polyethylene, iron(III), and small concentrations of butyl alcohol have slight but measurable effects on the rate of radiolytic gas generation. A palladium catalyst can control the pressure buildup over a plutonium(IV)-4 *M* nitric acid solution for about 4 weeks. Equations are given to calculate the pressure buildup as a function of free volume over the plutonium solution and the isotopic composition of the plutonium. Author (NSA)

N68-32686 National Lending Library for Science and Technology, Boston Spa (England).
RAPID COMPLEXOMETRIC DETERMINATION OF ZIRCONIUM-DIOXIDE WITH ALUMINUM, IRON AND TITANIUM-OXIDE (OPERATIONAL ANALYSIS)
J. Baumann and L. Lax 1 Jul. 1968 5 p Transl. into ENGLISH from Ber. Deut. Keram. Ges. (Bad Honnef/Rhein), v. 43, no. 1, 1966 p 21-22 *ITS* Transl. No. 1901
Available from Natl. Lending Library, Boston Spa, Engl.

Since in practice many products which contain zirconium dioxide also contain aluminum, a process is described for the complexometric determination of the oxide. In this comprehensive process the following can be determined regardless of the sequence

indicated: zirconium dioxide complexometric, sum of aluminum oxide + zircon dioxide complexometric, iron oxide photometric, and titanium dioxide photometric. It should be mentioned that an iron oxide content of more than 4% upsets the titration. The accuracy of the method is absolute at 1%. Author

N68-32691 National Lending Library for Science and Technology, Boston Spa (England).
THE STEREOCHEMISTRY OF NITROGEN HETEROCYCLES. 18: THE SYNTHESIS AND STEREOCHEMISTRY OF THE ISOMERS OF DECAHYDROQUINALDINE [STEREOKHIMIA AZOTISTIKH GETEROTSIKLOV. 18: SINTEZ I PROSTRANSTVENNOE STROENIE IZOMEROV DEKAGIDROKHINALDINA]
V. I. Artyukhin, D. V. Sokolov et al May 1968 17 p refs Transl. into ENGLISH from Izv. Akad. Nauk Kazakh. SSR, Ser. Khim (Alma-Ata), v. 17, no. 5, 1967 p 57–66
(RTS-4497) Available from Natl. Lending Library, Boston Spa, Engl.: 22s 6d

By reduction of the individual isomers of 4-keto-decahydroquinaldine by the Wolff–Kishner method in the Kuang–Minlon modification, all four theoretically possible isomers of decahydroquinaldine were obtained. The structure of the isomers of decahydroquinaldine obtained were assigned on the basis of the chemical facts and also with the help of infrared and paramagnetic resonance spectra. On hydrogenation of quinaldine on a Raney nickel catalyst under pressure there are obtained three isomers of decahydroquinaldine with an overwhelming predominance of isomers with equatorial methyl groups. Author

N68-32693# Nuklearni Institut Jozef Stefan, Ljubljana (Yugoslavia).
ON THE SYSTEM URANIUM TETRAFLUORIDE-HYDRAZINE
P. Glavic and J. Slivnik Feb. 1968 6 p Presented at the EUCHEM Inorg. Fluorine Conf., Leicester, Engl., Apr. 1967
(NIJS-R-524) CFSTI: HC$3.00/MF$0.65

The influence of water on the reaction of uranium tetrafluoride with anhydrous hydrazine was investigated. With no water present, a composition $UF_4 \cdot nN_2H_4$ (n being between 1.2 and 1.7) was obtained. When this product was treated with dilute hydrofluoric acid, a quantitative conversion to $N_2H_5UF_5$ was found. The products of hydrolysis after water was added were also examined. In this case, the solution was determined to decompose into $N_2H_5UF_5$ at 110°C and into uranium tetrafluoride at 350° C. The addition of fluoride ions to $N_2H_5UF_5$ yielded N_2H_5F, a not previously isolated compound with a melting point of 101° C. The infrared spectra of this compound, hydrazinium monochloride, and hydrazinium difluoride are compared. N.E.N.

N68-32705# Chemical Lab. RVO-TNO, Rijswijk (Netherlands).
ORGANOPHOSPHORUS COMPOUNDS VIII. DERIVATION OF THE MOLECULAR ROTATION OF (R)-SARIN USING BREWSTER'S ASYMMETRY RULES
H. L. Boter May 1968 8 p refs
(TDCK-50964; Rept.-1968-13) CFSTI: HC$3.00/MF$0.65

The conformational and atomic asymmetry rules given by Brewster permit the derivation of the negative sign of the molecular rotation of (*R*)-isopropyl methylphosphonofluoridate (sarin). The result corresponds with that obtained before using a correlative method. The experimental value of the molecular rotation lies between the limits calculated. Author

N68-32741# Rice Univ., Houston, Tex.
ION MOLECULE REACTIONS IN A 50 MEGACYCLE DISCHARGE
Stanley A. Studniarz May 1968 48 p refs Submitted for Publication
(Contract N00014-67-A-0226, Proj. Squid)
(TR-Rice-PU; AD-671233)

Studies of ions arriving at the orifice of a sampling probe from a plasma produced by an electrodeless discharge were made primarily by the use of a quadrupole mass spectrometer. Extensive investigation of the dependence of the relative ion intensities on the discharge conditions (particularly the pressure) and of the relative ionic composition as a function of the energy of the ions issuing from the orifice of the sampling probe were made. The results indicate that the ions collected and observed are formed in a narrow region in front of the probe orifice and that these ions gain most of their energy from the electric field of the sheath in a distance that is much less than a reaction mean free path. The collected and observed ions were found to originate in a distance of approximately one millimeter from the probe orifice. The average reaction time was found to be a few tenths of a microsecond and independent of the vessel geometry and dimensions. The average reaction time was relatively insensitive to changes in pressure. They were found to be reasonably constant for ions in several different gases and an attempt was made to relate them to the mean electron energy and the electron density. The observed reaction rate constants in the plasma were in reasonable agreement with those reported from electron impact sources. Author (TAB)

N68-32767 National Lending Library for Science and Technology, Boston Spa (England).
CONCERNING THE CHANGE IN THE DEGREE OF DISPERSION AND THE STRUCTURE OF TITANIUM DIOXIDE IN THE PROCESS OF SYNTHESIS OF A PIGMENT [K VOPROSU OB IZMENENII DISPERSNOSTI I STRUKTURY DVUOKISI TITANA V PROTSESSE SINTEZA PIGMENTA]
Yu. D. Dolmatov, A. I. Scheinkman, V. A. Toldin, and Yu. Ya. Bobyrenko Jul. 1968 10 p refs Transl. into ENGLISH from Lakokrasochnye Materialy i ikh Primenenie (Leningrad), no. 6, 1967 p 14–18
(RTS-4637) Available from Natl. Lending Library, Boston Spa, Engl.: 12s 6d

Experimental data are presented on a study of the growth of titanium dioxide particles in the process of thermal hydrolysis and calcination of ilmenite solutions of titanium and iron sulphates, and the relationships of the micro- and macrostructures of the particles are discussed. The thermal hydrolysis was conducted by boiling the solutions in the presence of 1% seeds in a three-necked flask with a reflux condenser. The precipitate of the hydrolyzate was filtered off from the hydrolytic acid and washed with water. The calcination was conducted in a porcelain crucible in a muffle furnace. A dispersion analysis was performed, and the dimensions of the microcrystals were determined. The results of the analysis of dimensions of the hydrolyzates and of their behavior in the process of calcination show that one of the most important properties of pigment dispersion is determined by the process of hydrolysis. B.S.D.

N68-32787 Rice Univ., Houston, Tex.
ATOMIC AND MOLECULAR REACTIONS IN AN OPTICALLY PUMPED HELIUM DISCHARGE
Hamilton Radford Byerly, Jr. (Ph.D. Thesis) 1967 128 p
Available from Univ. Microfilms: HC $6.20/MF $3.00 Order No. 67-13056

Reactions in excited helium gas are investigated using optical pumping techniques. Experiments conducted at Rice have demonstrated a short spin-lattice relaxation time for polarized He^3 ground state atoms and have shown this must be due to species present in the rf discharge which is necessary for optical pumping. Schearer (1966) proposed atom–atom interchange between molecular species and subsequent loss of polarization due to

spin-rotation coupling as a relaxation mechanism. Removal of He_2 by Ne has no effect on polarization. Removal of He^+ by Ne leads to a ≈20% effect on polarization, contrary to what was expected. Dissert. Abstr.

N68-32797# Purdue Univ., Lafayette, Ind. Project Squid Headquarters.
MOTION OF AN ION SWARM IN A CYLINDRICALLY SYMMETRIC DRIFT TUBE MASS SPECTROMETER
J. T. Moseley and I. R. Gatland. May 1968. 35 p. refs
(Contract N00014-67-A-0226)
(Squid-TR-GIT-3-PU; AD-671230)

Experimental studies of the transport properties and reactions of thermal energy, mass-identified ions in gases may be made with a drift tube coupled to a mass spectrometer. A detailed kinetic theory analysis of the combined drift-diffusion-reaction behavior of the ions is required in order to extract information on drift velocities, diffusion coefficients, and reaction rates from the raw experimental data. Such an analysis is presented for a drift tube mass spectrometer with a cylindrical symmetry. Author (TAB)

N68-32807 Polytechnic Inst. of Brooklyn, N. Y.
THE STRUCTURES AND MOTIONS OF SOME METHACRYLATE MONOMERS AND POLYMERS AS DETERMINED BY NMR METHODS
Wendell Maurice Lee (Ph.D. Thesis). 1967. 197 p.
Available from Univ. Microfilms: HC $9.00/MF $3.00. Order No. 67-13404

This research was undertaken to determine the influence of bulky side groups on the structures of polymers prepared under different conditions and by various methods of polymerization. Samples of these materials were used to investigate the kinds of motions in solid polymers. The methods of nuclear magnetic resonance spectroscopy were used to characterize the structures and motions of these materials. To achieve the structures and compositions which were useful in this study, several esters of 2-methyl propenoic acid were synthesized. The phenyl, pentafluorophenyl, and 1,1 dihydroheptafluorobutyl methacrylates were among the monomers prepared. The properties and the infrared and 60 MHz nmr spectra were those expected for a five-spin system of the AMX_3 type. A detailed analysis of some of these spectra was made employing first-order perturbation theory. The experimental and calculated spectra agreed very well. Dissert. Abstr.

N68-32813# Defense Documentation Center, Alexandria, Va.
A DDC BIBLIOGRAPHY ON LIQUID CRYSTAL, VOLUME 1
Jul. 1968. 39 p. refs
(DDC-TAS-68-11, V. 1; AD-671900)

An unclassified-unlimited bibliography was compiled for distribution to the Second International Conference on Liquid Crystal at Kent, Ohio. This bibliography is compiled in Accession Number (AD-Number) sequency only, and has two sets of indexes: a Personal Author Index and a Corporate Author Index. Author (TAB)

N68-32817# Naval Air Development Center, Johnsville, Pa. Dept. of Aerospace Medical Research.
A METHOD FOR DIGITAL CALCULATION OF ABSOLUTE FREE RADICAL CONCENTRATIONS
Freeman W. Cope. 21 May 1968. 13 p. refs
(NADC-MR-6804; REPT.-28; AD-671809)

An approximate method for digital calculation of absolute free radical concentration from the ESR spectrum is developed. The method avoids errors due to the use of finite amplitude of 100 kc modulation of magnetic field, and is shown to be valid for symmetrical ESR spectra and for asymmetric spectra which may be decomposed into sums of symmetric spectra. The method is convenient for use in a programmed digital desk calculator. Author (TAB)

N68-32822# National Bureau of Standards, Washington, D. C.
STANDARD X-RAY DIFFRACTION POWDER PATTERNS
Howard E. Swanson, M. C. Morris, Roger P. Stinchfield, and Eloise H. Evans. 9 Mar. 1962. 61 p.
(NBS-Monograph-25, Sec. 1; PB-178429) CFSTI: HC $3.00/MF $0.65

Forty-six standard X-ray diffraction powder patterns are presented. Fourteen are to replace twelve patterns already given in the X-ray Powder Data File, and thirty-four are for substances not previously included. The X-ray Powder Data File is a compilation of diffraction patterns from many sources and is used for the identification of unknown crystalline materials by matching spacing and intensity measurements. The patterns were made with a Geiger counter X-ray diffractometer, using samples of high purity. The d-values were assigned Miller indices determined by comparison with calculated interplanar spacings and from space group considerations. The densities and lattice constants were calculated, and the refractive indices were measured whenever possible. Author (USGRDR)

N68-32824# Oak Ridge National Lab., Tenn.
SIXTH RARE EARTH RESEARCH CONFERENCE
[1967] 809 p. refs. Conf. held at Gatlinburg, Tenn., 3–5 May 1967
(CONF-670502) CFSTI: HC $3.00/MF $0.65

Conference papers are presented on the properties of rare earth metals, compounds, and alloys, and on various aspects of their industrial preparation. For individual titles, see N68-32825 through N68-32895.

N68-32825# American Potash and Chemical Corp., New York.
RARE EARTH USES
Howard E. Kremers. *In* Oak Ridge Natl. Lab. 6th Rare Earth Res. Conf. [1967] p 1–6 (See N68-32824 20-06)

The rare-earth-producing industry has gone through several cycles of end-use patterns, and these are reviewed as they relate to technical progress made by industry. Author (NSA)

N68-32836# Oxford Univ. (England).
NON-STOICHIOMETRY AND CRYSTAL DEFECTS IN THE SOLID STATE CHEMISTRY OF THE LANTHANIDES
J. S. Anderson. *In* Oak Ridge Natl. Lab. 6th Rare Earth Res. Conf. [1967] p 112–131. refs (See N68-32824 20-06)

Three classes of lanthanide compounds, all largely ionic in character, which display a wealth of nonstoichiometric phenomena, were considered. The nitrides appear to come into that group of phases with such a high defect concentration that a completely random model is hardly acceptable. In the oxides and chalcogenides there are indications of strong tendencies to the maintenance of strict local ordering. All these compounds are therefore of particular interest in the present stage of defect theory, for which the central problem is to see how the one viewpoint, existence of regions of perfect local order in some coherent structural relationship to each other, can be fully harmonized with the experimental thermodynamics and the statistical thermodynamics of solids. Author (NSA)

N68-32837# Kennecott Copper Corp., Lexington, Mass. Ledgemont Lab.
POINT DEFECTS IN SOME RARE EARTH DIHYDRIDES

G. G. Libowitz and J. B. Lightstone *In* Oak Ridge Natl. Lab. 6th Rare Earth Res. Conf. [1967] p 132–144 refs (See N68-32824 20-06)

The rare earth dihydrides exhibit large positive and negative deviations from stoichiometry. By comparing experimental data for lanthanum, cerium, and gadolinium dihydrides with previously derived thermodynamic expressions relating chemical activities with deviations from stoichiometry, the defects responsible for the nonstoichiometry in these compounds may be identified. It is shown that the predominant defects in the stoichiometric rare earth dihydrides are Frenkel defects, with excess hydrogen interstitials causing positive deviations from stoichiometry and excess hydrogen vacancies causing negative deviations from stoichiometry. The derived equations also permitted calculation of the intrinsic Frenkel defect concentrations and energies and entropies of defect formation. Intrinsic defect concentrations ranged from 2 to 5% over the temperature range from 300 to 800°C. The vibrational entropy change for Frenkel defect formation was found to be negative and to contribute at least as much to the free energy of defect formation as does the enthalpy term. Author (NSA)

N68-32838# Texas Univ., Austin. Dept. of Chemical Engineering.
THE CRYSTAL CHEMISTRY OF SELECTED AB_2 RARE EARTH COMPOUNDS WITH Se, Te, AND Sb
R. Wang and H. Steinfink *In* Oak Ridge Natl. Lab. 6th Rare Earth Res. Conf. [1967] p 145–154 refs (See N68-32824 20-06)
(Grant AF AFOSR-806-65)

Crystal structures were determined for REB_2 compounds where RE is a rare earth and B an element of groups V and VI. Data are presented in tables and diagrams. NSA

N68-32839# Argonne National Lab., Ill. Metallurgy Div.
TERNARY COMPOUNDS HAVING THE $CeCu_2$-TYPE STRUCTURE
A. E. Dwight *In* Oak Ridge Natl. Lab. 6th Rare Earth Res. Conf. [1967] p 156–165 refs (See N68-32824 20-06)

The occurrence and unit cell constants of ten ternary compounds are reported. The compounds are formed when Y, Sm, Gd, Tb, Dy, Ho, Er, Tm, Yb, or Lu are alloyed with Ni and Ga in equiatomic proportions. These are members of a family of orthorhombic compounds with the $CeCu_2$-type structure. From X-rays diffraction data on powdered specimens, approximate atomic positional parameters and interatomic distances were obtained. An examination of the structure indicates that the rare earth atoms are aligned parallel to the b axis of the unit cell while the Ni and Ga atoms are aligned parallel to the a axis. The effect on the unit cell dimensions of ternary and quaternary substitutions is discussed. Author (NSA)

N68-32841# Oak Ridge National Lab., Tenn.
CHEMICAL AND ELECTRON OPTICAL STUDIES OF SOLS, GELS, AND OXIDE MICROSPHERES PREPARED FROM RARE EARTH HYDROXIDES
C. J. Hardy, S. R. Buxton, and T. E. Willmarth *In its* 6th Rare Earth Res. Conf. [1967] p 175–186 refs (See N68-32824 20-06)

Hydroxides of individual rare earths, principally praseodymium, neodymium, and europium, were precipitated from nitrate solutions with ammonium hydroxide, washed with water, and aged at 25° and 80°C to form sols containing about 0.5*M* metal hydroxide and a small amount of nitrate. Gel spheres of 100 to 800μ diameter were prepared by partial dehydration of droplets of sols suspended in 2-ethylhexanol. The structure of the precipitates, sols, and gels was examined by electron microscopy and electron diffraction. The initial precipitates of praseodymium and neodymium hydroxides consisted of amorphous particles of 30 to 60 Å diameter. The washed precipitates changed over a period of 1 to 2 hours at 25°C into translucent sols, which contained rod-shaped crystals of the trihydroxides loosely aggregated into bundles 600 to 1000 Å long and 50 to 100 Å wide. Author (NSA)

N68-32842# Naval Research Lab., Washington, D. C.
STRUCTURE OF LANTHANUM DIHYDROXY CHLORIDE
Forrest L. Carter *In* Oak Ridge Natl. Lab. 6th Rare Earth Res. Conf. [1967] p 187–193 refs (See N68-32824 20-06)

Prepared hydrothermally $La(OH)_2Cl$ crystallizes in a monoclinic form with unit cell parameters of a = 6.318, b = 3.993, and c = 6.931 Å and β = 113.86°. The structure is noncentrosymmetric and belongs to the $P2_1$–$C2$ space group. Lanthanum has a coordination sphere of eight, of which two chlorines and four oxygens form a distorted trigonal prism. The structure is primarily a layer type with a structural backbone of lanthanum and oxygen. Hydrogen bonds between the hydroxyl groups and chlorine are responsible for the interlayer bonding. Author (NSA)

N68-32843# Pennsylvania State Univ., University Park. Materials Research Lab.
CRYSTAL CHEMISTRY AND PHASE EQUILIBRIA IN THE SYSTEM Eu-Ti-O
Gregory J. McCarthy, William B. White, and Rustum Roy *In* Oak Ridge Natl. Lab. 6th Rare Earth Res. Conf. [1967] p 194–199 refs (See N68-32824 20-06)

The crystal chemistry and phase equilibria of the ternary system Eu–Ti–O were investigated in open and closed systems in the temperature range from 900 to 1500°C. The known bounding binary systems include the compounds Eu_2O_3, Eu_3O_4, and EuO on the europium–oxygen side and TiO_2, the Ti_nO_{2n-1} homologous series, Ti_3O_5, Ti_2O_3, TiO, Ti_2O, and Ti_3O on the titanium–oxygen side. The join Eu_2O_3–TiO_2 contains in addition to the known pyrochlore structure $Eu_2Ti_2O_7$, the monoclinic compound Eu_2TiO_5. On the joins Eu_2O_3–Ti_2O_3 and EuO–TiO_2, the perovskite $EuTiO_3$ with divalent europium and tetravalent titanium is shown to have an extremely wide range of stability. The join EuO–TiO is apparently not binary and bulk compositions along this join dissociate into oxygen-rich and oxygen-poor phases. Particular attention was placed on the highly reduced compounds in the metal-rich section of the diagram because of the possibility of finding compounds with unusual electrical properties. Author (NSA)

N68-32844# Du Pont De Nemours (E. I.) and Co., Wilmington, Del.
SOME TENSIMETRIC STUDIES OF THE SYSTEM Ce(y)Tb(1-y)O(x)
J. Kordis and LeRoy Eyring (Ariz. State Univ.) *In* Oak Ridge Natl. Lab. 6th Rare Earth Res. Conf. [1967] p 200–212 refs (See N68-32824 20-06)

The isobaric technique applied to a study of P, T, x relationships proved to be a powerful method of revealing the intricacies of the complex phase relationships in pure PrO_x and TbO_x systems. The sorting out of this pattern of ordered intermediate phases of narrow ranges of composition (homologous series), phases of wide composition range (nonstoichiometric phases), "pseudo phase" formation, which accompanies phase reactions with symmetry reduction, and chemical hysteresis, which is generally observed in two phase regions, will advance the understanding of the detailed nature of the solid state and the reactions that solids undergo. A study of the system $Ce_yTb_{1-y}O_x$ was accomplished to reveal the effect of cation substitution between analogous systems on their thermodynamic behavior as revealed by tensimetric measurements. Author (NSA)

N68-32845# Pennsylvania State Univ., University Park. Materials Research Lab.
EQUILIBRIA, POINT DEFECT NATURE AND KINETICS IN THE SYSTEMS OF RARE EARTHS AND DIVALENT OR TETRAVALENT OXIDES

Austum Roy, A. M. Diness, and T. L. Barry *In* Oak Ridge Natl. Lab. 6th Rare Earth Res. Conf. [1967] p 213–222 refs Sponsored by AF Office of Sci. Res. (See N68-32824 20-06)

Detailed investigations by quenching, DTA, high temperature, x radiation, and high-pressure water catalysis were made on the systems $CaO–Yb_2O_3$, $CaO–Gd_2O_3$, $CaO–La_2O_3$, $ThO_2–Yb_2O_3$, $ThO_2–Gd_2O_3$, and $ThO_2–La_2O_3$. New or revised equilibrium diagrams are presented for all the systems. One feature is the large number of new compounds previously unreported. In the $CaO–Yb_2O_3$ system for example, there are four compounds, all decomposing below 1800°C. In the $ThO_2–La_2O_3$ system, there are two previously unreported compounds. The extent of crystalline solubility of the rear earths in CaO and ThO_2 does not follow the expected dependence on ionic radii or ionic field strength differences. An anion vacancy model is confirmed for ThO_2 (matrix)–Ln_2O_3 (solute) solutions near 1900°C; a cation vacancy model for $CaO–Ln_2O_3$; and an interstitial anion model for $Gd_2O_3–ThO_2$, an extensive series of crystalline solutions with the C-type structure. The kinetics of the solid-state decomposition of $CaYb_2O_4 \rightarrow CaO + Yb_2O_3$ follows zero order kinetics. Interpretation of these and similar kinetic data is discussed. Author (NSA)

N68-32846# Oak Ridge National Lab., Tenn.
CRYSTAL STRUCTURES OF YTTERBIUM SULFIDE AND MANGANESE YTTERBIUM SULFIDE
R. Chevalier, P. Laueile, and J. Flahaut *In its* 6th Rare Earth Res. Conf. [1967] p 225–227 (See N68-32824 20-06)

Crystallographic studies were made of the structure of Yb_3S_4 and MnY_2S_4. The Yb_3S_4 is orthorhombic with a cell of dimensions: a = 12.71, b = 3.81, and c = 12.88 Å and belongs to space group PnMa. MnY_2S_4, orthorhombic too, shows a cell of similar dimensions: a = 3.78, b = 12.64, and c = 12.74 Å but the systematic extinctions are characteristic of the space group cmcm. NSA

N68-32850# Los Alamos Scientific Lab., N. Mex.
ENERGY LEVELS OF TETRAVALENT DYSPROSIUM. FLUORESCENCE AND ABSORPTION SPECTRA OF CESIUM DYSPROSIUM (4) HEPTAFLUORIDE
Louis P. Varga (Okla. State Univ.), and Larned P. Asprey *In* Oak Ridge Natl. Lab. 6th Rare Earth Res. Conf. [1967] p 259–270 refs (See N68-32824 20-06)

When cesium salts of dysprosium containing 3:1 mole ratio cesium: dysprosium are reacted for several hours with fluorine gas at 200 to 250°C and 50 to 60 psig, the white Dy(III) salt is converted to a bright orange material with an empirical formula approaching Cs_3DyF_7. Absorption and fluorescence spectra, of fluorocarbon mulls of this material at liquid N_2 temperatures were taken using continuous recording spectrophotometers and the low-lying F^n transitions were analyzed for evidence of the Dy(IV) species with the $4f^9$ configuration. Since Dy(IV) is isoelectronic with Tb(III), comparison of the middle and near infrared absorption spectra of the orange fluorination product against that of some Tb(III) compounds and the parent Dy(III) compound allowed identification of all the components of the ^7F ground state multiplet for Dy(IV). Less effective screening of the nuclear charge in tetravalent dysprosium resulted in a raising of the 4f energy levels compared with isoelectronic Tb(III), as expected. Author (NSA)

N68-32852# Centre National de la Recherche Scientifique, Bellevue (France).
PREPARATION AND PROPERTIES OF SOME FLUORESCENT RARE EARTH COMPOUNDS
Jean Loriers and Rudolf Heindl (Lab. Central de Telecomun.) *In* Oak Ridge Natl. Lab. 6th Rare Earth Res. Conf. [1967] p 283–294 refs (See N68-32824 20-06)

The preparation and properties of some fluorescent inorganic rare earth compounds derived from the orthovanadates of general formula $YtVO_4$ (Yt=Y, Gd, Lu, or Sc) by balanced cation substitution are described. Two series of compounds are considered: double and polycationic orthovanadates with zircon structure and $ABVO_4$–type compounds. When doped with europium or other lanthanides, these compounds have fluorescent properties similar to those observed with yttrium orthovanadate as host material. The fluorescence spectra under uv excitation have some interesting properties compared with those of usual fluorescent orthovanadates. The influence on intensity of emission lines was studied with respect to changes in substitution elements and concentration of doping lanthanide. Author (NSA)

N68-32856# Los Alamos Scientific Lab., N. Mex.
HIGH-TEMPERATURE NEUTRON DIFFRACTION STUDY OF LaC_2 AND YC_2
A. L. Bowman, N. H. Krikorian, G. P. Arnold, T. C. Wallace, and N. G. Nereson *In* Oak Ridge Natl. Lab. 6th Rare Earth Res. Conf. [1967] p 311–317 refs (See N68-32824 20-06)

The dicarbides of lanthanum and yttrium were examined by high-temperature neutron- and X-ray-diffraction and by thermal analysis. A tetragonal to cubic transformation has been observed at 1060°C for LaC_2 and at 1320°C for YC_2. The lattice parameters of LaC_2 are a = 4.0, c = 6.58Å at 900°C and a = 6.02Å at 1150°C. The parameters of YC_2 are a = 3.74, c = 6.20Å at 1100°C and a = 5.66Å at 1400°C. The structure of the tetragonal phases was found to be the C11a calcium carbide-type, in agreement with previous room temperature results. The structure of the cubic phases is the B1 sodium chloride-type with C_2 groups, similar to the structure of KCN. Both phases are isomorphous with the corresponding uranium dicarbide phases. Author

N68-32857# Illinois Univ., Urbana. Noyes Chemical Lab.
CURRENT PROBLEMS AND STUDIES IN THE COORDINATION CHEMISTRY OF THE RARE EARTH-METAL IONS
Therald Moeller *In* Oak Ridge Natl. Lab. 6th Rare Earth Res. Conf. [1967] p 318–328 refs (See N68-32824 20-06)

The problems to be considered include the structure of and bonding within complex species, thermodynamic stabilities of the complex species in solution, those properties that arise from f configurations, and the applications that depend upon specific properties of individual complexes. Structural studies support the view that coordination number six and octahedral geometry are the exception rather than the rule. Although the bonding between cation and ligand is, by general agreement, primarily electrostatic in nature, small but significant covalent contributions are indicated by spectral and other studies. Ligand field stabilization, however, is minimal. The irregularities in the thermodynamic stabilities (i.e., formation constants, free energy changes) of complexes with particular ligands as the ion Ln^{3+} is varied appear to result from combinations of various factors. Author (NSA)

N68-32858# Iowa State Univ. of Science and Technology, Ames. Dept. of Chemistry.
OM_4 TETRAHEDRON LINKAGES—AN IMPORTANT FEATURE IN RARE EARTH OXIDE AND OXYSALT STRUCTURES
Paul E. Caro *In* Oak Ridge Natl. Lab. 6th Rare Earth Res. Conf. [1967] p 329–340 refs (See N68-32824 20-06)

Rare earth oxides and oxysalt structures are considered with respect to the coordination of the oxygen atom. Metallic atoms are found to be in tetrahedral positions around the oxygen atom, and all known structures can be described as tridimensional or bidimensional packing of OM_4 tetrahedra joined together by sharing of edges. In A–M_2O_3, B–M_2O_3 structures and the oxysalts the packed tetrahedra appear as an infinite polymeric complex cation $(MO)_x^{x+}$. Possible implications for the structure of nonstoichiometric oxides are discussed. Optical studies show that the rare earth atoms in oxides are to some extent covalently bonded, and it is

suggested that the oxygen atoms are involved in a directional bonding, possibly of a sp^3 type. Author (NSA)

N68-32859# Iowa State Univ. of Science and Technology, Ames. Inst. for Atomic Research.

AUGMENTING THE SEPARATION OF GADOLINIUM AND EUROPIUM AND EUROPIUM AND SAMARIUM MIXTURES IN ION EXCHANGE ELUTIONS WITH EDTA

J. E. Powell and H. R. Burkholder *In* Oak Ridge Natl. Lab. 6th Rare Earth Res. Conf. [1967] p 343–354 refs (See N68-32824 20-06)

Scrutiny of thermodynamic data and proposed models for hydrated ethylenediaminetetraacetato chelates of the rare earths suggested a means of improving displacement chromatographic separations of Gd–Eu and Eu–Sm mixtures on cation exchange columns. Increasing the operating temperature from 25 to 92°C effected an increase in the Gd–Eu separation factor from a skimpy 1.1 to a robust 1.47 ± 0.07 and the Eu–Sm separation factor from 1.4 to 1.8, presumably by destroying a degree of internal hydrogen bonding, which occurs to a varying extent in the case of the less-constrained lighter rare earth EDTA chelates at room temperature. Apparently this type of internal hydrogen bonding is not possible in the case of smaller heavier rare earth EDTA chelates (Gd through Lu). Author (NSA)

N68-32860# Los Alamos Scientific Lab., N. Mex.

A STUDY OF SOME GEOMETRICAL AND MECHANICAL EFFECTS ON THE EXTRACTION OF EUROPIUM BY LITHIUM AMALGAM FROM AQUEOUS LITHIUM CITRATE ELECTROLYTES

John B. Goddard, John M. Campbell, and E. I. Onstott *In* Oak Ridge Natl. Lab. 6th Rare Earth Res. Conf. [1967] p 355–363 (See N68-32824 20-06)

The amount of Eu extracted into lithium amalgam from aqueous lithium citrate electrolytes was enhanced when the phases were separated by dumping the amalgam and electrolyte from the reaction vessel into a second vessel containing a chloroform layer to constrain the electrolyte phase. As much as 39% of the Eu in the electrolyte was extracted in a time interval estimated to be less than one second using this phase separation procedure. If the phases were separated by a second technique by adding the chloroform layer to the reaction vessel, other conditions remaining the same, the amount of Eu removed in this short time interval was reduced to 3.5%. The amount of Eu extracted by this faster mechanism was found to increase with the amount of amalgam used whereas the steady-state extraction rate in the expected manner with the rate being proportional to surface area, but a change in the surface area of the amalgam exposed to the electrolyte did not significantly affect the extraction of Eu by the faster mechanism when the amount of amalgam was kept constant. Author

N68-32861# Los Alamos Sciantific Lab., N. Mex.

THE PREPARATION OF THORIUM DICARBONATE, URANYL CARBONATE AND THE SESQUICARBONATES OF La, Ce, Pr, Tb AND Y FROM THE CORRESPONDING ANHYDROUS ACETATES

E. L. Head *In* Oak Ridge Natl. Lab. 6th Rare Earth Res. Conf. [1967] p 366–373 refs (See N68-32824 20-06)

Two methods for the preparation of the rare earth sesquicarbonates were described previously. Those studies were continued and a method was developed for the preparation of La, Ce, Pr, Tb, and Y sesquicarbonates; thorium dicarbonate; and uranyl carbonate from their respective anhydrous acetates. Methods are described for the preparation of the various anhydrous acetates used. Typical analytical data for the compounds prepared and thermal decomposition diagrams for the thorium dicarbonate and uranyl carbonate are given. The method consistently produced carbonate product yields of about 75 to 80% for the sesquicarbonates, 90 to 95% for thorium dicarbonate, and 90 to 93% for uranyl carbonate. Use of the hydrated acetate salt in the case of La, Ce, and Pr produced carbonates much more difficult to filter and in yields of less than 50%. Author (NSA)

N68-32862# Michigan State Univ., East Lansing. Dept. of Chemistry.

PREPARATION, CHARACTERIZATION, AND SOME THERMODYNAMIC PROPERTIES OF LANTHANUM–OXIDE-CARBIDE, $La_2O_2C_2$

A. Duane Butherus and Harry A. Rick *IN* Oak Ridge Natl. Lab. 6th Rare Earth Res. Conf. [1967] p 374–384 refs (See N68-32824 20-06)

A lanthanum–oxide–carbide of the general formula $La_2O_2C_2$ was prepared by the reaction of molten lanthanum metal with carbon monoxide, by the reaction of lanthanum metal with the sesquioxide and carbon, by the reaction of lanthanum dicarbide with the sesquioxide and carbon, and by the reaction of sesquioxide with graphite. All reactions were carried out in a carbon monoxide atmosphere. Some of the preparations which were zone refined by slow passage of an arc over an approximately 7 cm long sample produced a crystalline phase which both X-ray powder diffraction and micrographic analysis indicated to be monophasic. Analysis of this specimen for total carbon, free carbon, and metal indicated the composition mentioned previously. Vapor phase chromatographic analysis of the acid hydrolysis product indicates the principal species to be acetylene. Author

N68-32863# Freiburg Univ. (West Germany).

PRECIPITATION OF RATE EARTH OXIDES FROM MOLTEN SALTS

Georg Brauer *In* Oak Ridge Natl. Lab. 6th Rare Earth Res. Conf. [1967] p 385–390 refs (See N68-32824 20-06)

Rare earth oxides or oxide nitrates were precipitated from anhydrous rare earth nitrates dissolved in molten mixtures of alkali nitrates by self-decomposition at 400°C. La and Nd form oxide nitrates under these conditions. Ce, Pr, and Tb are precipitated as higher oxides CeO_2, $PrO_{1.83}$, and $TbO_{1.80}$, respectively. The other rare earths are precipitated as sesquioxides with the B-type structure (Sm, Eu, Gd) or with the C-type structure (Dy through Lu). Thus, the B-type modifications of Sm_2O_3, Eu_2O_3 and Gd_2O_3 must be the really stable phases at 400°C. A new version of the phase stability diagram of the A-, B-, and C-type polymorphs of the rate earth sesquioxides is proposed. Author (NSA)

N68-32864# Rajasthan Univ., Jaipur (India). Chemical Labs.

ALKOXY AND ACYLOXY DERIVATIVES OF LANTHANONS

R. C. Mehrotra, J. M. Batware, S. N. Misra, T. N. Misra, and U. D. Tripathi *In* Oak Ridge Natl. Lab. 6th Rare Earth Res. Conf. [1967] p 392–402 refs (See N68-32824 20-06)

The preparation and properties of rare earth alcoholates, $M(OR)_3$ 3ROH, are described. The triisopropanolates serve as convenient starting materials for the synthesis of triisopropoxides, $M(OPr^i)_3$, by refluxing their solutions in isopropanol-benzene mixture with stoichiometric quantities of sodium isopropoxide. The isopropoxides can in some cases be purified by crystallization and volatilization and undergo alcoholysis reactions by which other alkoxide derivatives can be prepared. The reactions of these alkoxides particularly of isopropoxides were studied in benzene with acetyl chloride, acetyl bromide, phenols, glycols, β-diketones, and β-ketoesters. A wide variety of metalloorganic compounds including anhydrous β-diketonates of lanthanons were synthesized. The acyloxy derivatives of rare earths, $M(OOCR)_3$ (where R is $C_{11}H_{23}$, $C_{15}H_{31}$, and $C_{17}H_{35}$) were synthesized by treating their chlorides or nitrates with appropriate sodium soap solutions in water. The precipated triacylates can be crystallized from benzene in which they depict monomeric behavior. Author (NSA)

N68-32889# Missouri Univ., Rolla. Dept. of Metallurgical Engineering.
SYNTHESIS AND IDENTIFICATION OF INTERMETALLIC COMPOUNDS IN THE Fe–Ho SYSTEM
T. J. O'Keefe, G. E. Roe, and W. J. James *IN* Oak Ridge Natl. Lab. 6th Rare Earth Res. Conf. [1967] p 449–451 (See N68-32824 20-06)

Intermediate phases in the iron–holmium system were investigated by means of x-ray diffraction, electron microprobe analysis, and metallographic techniques. The phases either definitely or tentatively identified were $HoFe_2$, $HoFe_3$, Ho_6Fe_{23}, $HoFe_5$, and Ho_2Fe_{17}. The lattice parameters were determined by the Straumanis technique using Fe Kα radiation. Work in progress is also discussed. Author (NSA)

N68-32890# Lunex Co., Pleasant Vally, Iowa.
CHEMICAL ASPECTS OF INDUSTRIAL PREPARATION OF THE RARE EARTH METALS
J. L. Moriarty *In* Oak Ridge Natl. Lab. 6th Rare Earth Res. Conf. [1967] p 653–664 refs (See N68-32824 20-06)

Experience with the industrial process chemistry involved in producing rare earth metals is reviewed. Fluoride and chloride preparatory methods are discussed along with tabular presentations of some physical property data. Metallothermic reduction techniques as applied to both processes are shown. Also a comparison of representative metal microstructures and analyses is made. Employing the chloride process, oxide conversions in excess of 97% and yields of recovered metal from 77 to 86% of theoretical are expected. Average typical spectrographic and gas analyses indicate that a final product purity of 99.9+% is common for the metals prepared. The thermodynamic and vapor pressure characteristics of several of the rare earths permit direct reduction of their oxide to metal. High-purity metals behave nicely and can be readily cast, rolled, and machined under the appropriate conditions.
Author (NSA)

N68-32891# Michigan Chemical Corp., St. Louis.
EFFECT OF TEMPERATURE ON THE HEDTA- AND EDTA-ELUTION POSITIONS OF YTTRIUM IN THE RARE-EARTH SEQUENCE
J. R. Morton and D. B. James *In* Oak Ridge Natl. Lab. 6th Rare Earth Res. Conf. [1967] p 667–677 refs (See N68-32824 20-06)

Varying the elution temperature in the ion-exchange separation of an yttrium-lanthanide mixture shifts the elution position of yttrium. With HEDTA as the eluant the position of yttrium at room temperature is slightly ahead of neodymium, at 90 to 95°C it is between terbium and gadolinium, and at 40 to 50°C it is in the vacant promethium position. A practical scheme for the purification of yttrium has been devised using this shift of position. With EDTA, the elution position of yttrium is always between terbium and dysprosium; but increasing temperature decreases the dysprosium-yttrium separation factor, possibly negating any increased separation efficiency resulting from the decreased theoretical plate height. Author (NSA)

N68-32892# American Potash and Chemical Corp., Los Angeles.
COMMERCIAL ION EXCHANGE SEPARATION OF THE RARE EARTHS
W. L. Silvernail and M. M. Woyski In Oak Ridge Natl. Lab. 6th Rare Earth Res. Conf. [1967] p 678–690 refs (See N68-32824 20-06)

Rapid production of yttrium is achieved by making use of the different positions of yttrium in the elution sequence with different eluting agents. Elution with HEDTA is used to separate the heavy elements. This is followed by elution with EDTA to separate the light elements. Elution with EDTA is carried out with a preprepared pre-prepared solution of rare earth chelate. This permits operation at much higher concentration and facilitates the recovery of EDTA. The use of non-rare earth retainers is eliminated. In actual operation, columns loaded with crude material are introduced into the elution train at suitable intervals resulting in almost continuous production of purified product. The use of pre-prepared solutions of rare earth chelates is also applicable to the separation of other rare earths with a gain in operating efficiency. Some fundamentals of commerical ion-exchange operation are considered. Author (NSA)

N68-32893# Bureau of Mines, Reno, Nev. Metallurgy Research Center.
RECOVERY OF CERIUM AND LANTHANUM BY OZONATION OF LANTHANIDE SOLUTIONS
D. J. Bauer and R. E. Lindstrom *In* Oak Ridge Natl. Lab. 6th Rare Earth Res. Conf. [1967] p 692–700 refs (See N68-32824 20-06)

Oxidation of lanthanide solutions with ozone at pH 4.5 and ambient temperature results in precipitation of 98% of the original cerium present. Corresponding cerium purity is increased from 50 to 98%. Alternatively, ozonation at pH 6.5 and 85°C differentially precipitates cerium and heavier elements, and leaves 89% of the original lanthanum in solution at a purity of 95%. Subsequent recovery of cerium from the heavier elements is accomplished by dissolving the precipitate and reoxidizing the cerium with ozone at pH 4.5 and ambient temperature. The filtrate contains an enriched praseodymium-neodymium-samarium-europium mixture that is amenable to separation by ion exchange or solvent extraction. Author (NSA)

N68-32894# Bureau of Mines, Reno, Nev. Metallurgy Research Center.
DIRECT ELECTROLYSIS OF RARE-EARTH OXIDES TO METALS AND ALLOYS IN FLUORIDE MELTS
F. Morrice, E. S. Shedd, and T. A. Henrie *In* Oak Ridge Natl. Lab. 6th Rare Earth Res. Conf. [1967] p 714–727 refs (See N68-32824 20-06)

Techniques developed by the Federal Bureau of Mines for the preparation of high-purity rare earth metals and their alloys by electrolysis of the oxides in fluoride media are discussed. Individual cerium, lanthanum, neodymium, praseodymium, dysprosium, gadolinium, and yttrium metals, as well as the mixture "didymium," and specific alloy compositions of these metals and samarium with iron, nickel, chromium, and cobalt, were prepared. Individual metals were electrodeposited in the liquid state on tungsten or molybdenum cathodes. Alloys were prepared by electrodepositing the rare earth metal on a consumable base metal cathode at a temperature above the melting point of the eutectic formed between the rare earth element and the cathode material. Cells for electrowinning metal products in gram and pound quantities, along with methods for the continuous electrowinning of cerium and lanthanum, are described. Author (NSA)

N68-32895# Ronson Metals Corp., Newark, N. J.
COMMERCIAL PRODUCTION OF RARE EARTH METALS BY FUSED SALT ELECTROLYSIS
I. S. Hirschhorn *In* Oak Ridge Natl. Lab. 6th Rare Earth Res. Conf. [1967] p 728–738 refs (See N68-32824 20-06)

The commercial production of rare earth metals by fused-salt electrolytic methods is described. These methods are used to make mischmetal, cerium, lanthanum, and didymium (Nd + Pr). The feed materials consist essentially of anhydrous chlorides of the metal to be produced, augmented by additions of non-rare earth salts to yield an electrolyte with satisfactory properties for reduction. The rare earths are derived either from monazite or from bastnasite ores. The anhydrous chlorides are manufactured from the hydrated chlorides by methods that minimize oxidation or hydrolysis. Alternatively, anhydrous chlorides may be used, which result from

the direct chlorination of rare earth ores by the Goldschmidt process. These are particularly suitable for electrolysis due to their very low oxychloride content. Fluorides and oxides of the rare earths are produced by wet chemical methods to provide the relatively small quantities of these compounds now used for commercial fused salt

N68-32897 Northwestern Univ., Evanston, Ill.
LEWIS BASICITY OF METALS
Malcolm Pratt Johnson (Ph.D. Thesis) 1967 151 p
Available from Univ. Microfilms: HC $7.20/MF $3.00 Order No. 67-15254

A series of transition metal bases were shown to react with BF_3 and BCl_3 to give the following adducts: I_3. When exposed to diborane these tetrahedrally coordinated boron, and the most reasonable structure involves metal–BX_3 donor-acceptor bond formation. Attempts to add BF_3 to $(C_5H_5)Mo(Co)\overline{3}$ and (C_5H_5)–$W(CO)\overline{3}$ resulted in their dimers as the principle horizontal Adducts with BF_3 and $(CH_3C_5H_4)Mn(CO)_3$. $(C_5H_5)Co(CO)_2$ or $(C_5H_5)Rh(CO)_2$ did not form. Anions containing tin and germanium were found to react with a variety of acids to yield complexes containing donor-addeptor bonds. New compounds isolated were $Cl_3SnBF\overline{3}$. $Cl_3SnBCl\overline{3}$ = $Cl_3SnBBr\overline{3}$. $Cl_3SnGa(CH_3)\overline{3}$. $Br_3SnBF\overline{3}$. $Br_3SnBCl\overline{3}$. $Br_3SnBBr\overline{3}$. $Cl_3GeBF\overline{3}$ and $Cl_3GeBCl\overline{3}$. A complete assignment of the infrared spectra was made for $SnCl\overline{3}$ and $GeCl\overline{3}$ and their BF_3 adducts. Dissert. Abstr.

N68-32916 Ohio State Univ., Columbus.
ANHARMONIC FORCE CONSTANTS OF LINEAR X–Y–Y–X MOLECULES BASED ON VALENCE-COORDINATE FORMULATION
Ludwig Ivan Epstein (Ph.D. Thesis) 1967 111 p
Available from Univ. Microfilms: HC $5.60/MF $3.00 Order No. 67-16275

The expression for the potential energy of the molecule is customarily expanded as a sum of terms which are quadratic, cubic, or quartic in the coordinates, terms of degree higher than quartic being negligible. The coefficients of these terms depend on the choice of coordinates. In Keller's thesis, certain quantities whose values can be obtained from the observed spectrum are given in terms of the potential coefficients referring to normal coordinates. In the present dissertation, these potential coefficients have been expressed in terms of those referring to the valence coordinates used here, so that the experimental quantities can also be expressed in terms of the latter. With the aid of data obtained from the observed spectrum, it should be possible to solve for the new coefficients. All mathematical results have been checked for errors by methods described in this dissertation. Whereas only some but not all of the old quartic coefficients manifested themselves in the spectrum, all the new quartic coefficients contribute and should be capable of determination. The references cited have been checked for errors, and some corrections have been noted. Dissert. Abstr.

N68-32918*# Brigham Young Univ., Provo, Utah.
STUDIES OF REACTION GEOMETRY IN OXIDATION AND REDUCTION OF THE ALKALINE SILVER ELECTRODE
Eliot A. Butler and Angus U. Blackham 15 Aug. 1968 40 p refs Prepared for JPL
(Contracts NAS7-100; JPL-952268)
(NASA-CR-96278; QR-1) CFSTI: HC $3.00/MF $0.65 CSCL 07D

Apparatus has been constructed for the cyclic current-step method of determining the kinetic parameters i_0, α, and K^0 for the electrolytic oxidation of silver in ammoniacal solution. Numerical values of 0.73 ma/cm^2, 0.82, and 1.8×10^{-2} cm/sec were obtained for i_0, α, and k^0 compared with the values, 1.1 ma/cm^2, 0.67, and 6.3×10^{-2} cm/sec obtained by the classical galvanostatic method from our polarization data. Experiments for applying the cyclic current-step method to the determination of these kinetic parameters for the Ag–Ag_2O and the Ag_2O–AgO systems are outlined. A definite decrease in charge-acceptance with increase in potential over the Ag–Ag_2O region is seen. Two methods of surface preparation have been found to meet the more critical demands of studying the effects of ultrasonic vibration on charging capacity. Electropolishing of silver foil in a cyanide bath produced bright, clean surfaces with an average roughness factor of 1.08 with an average deviation of 2.5%. Vapor deposition of silver in glass substrates produced clean surfaces with an error in reproducibility of less than 2% in surface area. Author

N68-32926 National Lending Library for Science and Technology, Boston Spa (England).
INVESTIGATION INTO OXIDATION OF NIOBIUM [IZUCHENIE OKISLENIYA NIOBIYA]
D. I. Lainer et al Feb. 1968 14 p refs Transl. into ENGLISH from Tr. Gos. Nauchn.-Issled. i Proektn. Inst. Spavov, i Aerbat Tavetn. Met., no. 24, 1965 p 75–85
(RTS-4263) Available from Natl. Lending Library, Boston Spa, Engl.: 27s 6d

Oxidation processes are studied using niobium produced by the sodium-thermal process and remelted in arc and electron beam furnaces, and containing the following impurities by mass: 0.1% to 0.8% C, 0.01% to 0.08% O_2, and 0.01 to 0.05% N_2. The ingots were forged, planed, and vacuum annealed at 1250°C. The characteristics of the kinetic laws of niobium oxidation are determined for various temperature ranges and time intervals, and weight changes during oxidation are plotted. Electron and X-ray diffraction analyses were also conducted to determine the phase transformation and texture of the scale. Experimental results indicate: (1) In the 500° to 800° C range, the scale consists of at least two α-Nb_2O_5 layers; however, the lower layer adheres firmly to the metal and has a pronounced texture, whereas the top layer flakes off during cooling and has no texture. The composition of the layer in which flaking occurs includes the NbO phase and a phase which is an unknown oxide of niobium. The NbO phase in the scale is particularly pronounced during short term oxidation for 45 s at 1000°C. M.G.J.

N68-32932 Polytechnic Inst. of Brooklyn, N. Y.
THE STABILITY CONSTANTS OF THE TETRAHEDRAL NICKEL HALIDES IN DIMETHYL SULFONE
John Charles Hasson (Ph.D. Thesis) 1967 113 p
Available from Univ. Microfilms: HC $5.60/MF $3.00 Order No. 67-13392

The purpose of this investigation was to determine the composition of the tetrahedral nickel(II) halide complexes and the octahedral nickel(II) nitrate complexes and to measure their stability constants in 2 M solutions of lithium perchlorate in dimethyl sulfone at 125°C. Potentiometric methods were used. An amalgamated nickel wire electrode, which was reversible to nickel(II) ions, was developed and used in conjunction with a silver–0.01M silver perchlorate reference electrode. Analysis of the plots of the potential of the amalgamated nickel wire electrode in the dimethyl sulfone solutions containing excess halide versus the logarithm of the halide concentration showed that the predominating species was the mononuclear tetrahalonickelate(II) anion in each case and that the logarithms of the overall stability constants were $11.18 \pm .21$, $12.04 \pm .12$ and $9.77 \pm .36$ for the chloride, bromide and iodide, respectively. Dissert Abstr.

N68-32944 Pennsylvania State Univ., University Park.
VAPORIZATION OF ARSENIC AND ANTIMONY SINGLE CRYSTALS. 1: KINETICS OF SUBLIMATION. 2: REACTION WITH GASEOUS OXYGEN
Pang-Kai Lee (Ph.D. Thesis) 1967 206 p
Available from Univ. Microfilms: HC $9.45/MF $3.00 Order No. 67-15400

Metallic arsenic and antimony sublime anomalously in that the rate-controlling step in the sublimation process has an enthalpy of activation greater than the enthalpy of vaporization at equilibrium. For antimony there is an induction period for every freshly cleaved crystal sample, but after a certain amount of material has vaporized, the rate attains an unchanging, reproducible steady-state. At 606–696°K the vaporization coefficient of antimony (111) face is relatively high, so that the rate of free vaporization had to be corrected for the molecular flow resistance of the vaporization tubes. The reaction efficiencies of gaseous oxygen with single crystals of arsenic and antimony, primarily (111) faces, were studied. Measurements were made of the change in sublimation rate under normal vacuum ($P(O_2) < 10^{-9}$ torr) and under oxygen partial pressures of 10^{-8} to 10^{-4} torr. Dissert. Abstr.

N68-32997# Michigan State Univ., East Lansing. Dept. of Chemistry.
FORCE CONSTANTS OF NONMETAL FLUORIDES: THE VIBRATIONAL ASSIGNMENT OF IF_6^+
John L. Hardwick (Ga. Inst. of Tech.) and George E. Leroi May 1968 9 p refs Submitted for publication
(Contract N00014-68-A-0109-0004)
(TR-1(6); AD-670554)

The force constants of a series of nonmetal hexafluorides were calculated using a modified Urey-Bradley Force Field, and the results correlated according to the position of the central atom in the periodic table. On this basis, the recent vibrational assignment of IF6(+) by Christe and Sawodny was questioned; it is suggested that the nu1 and nu2 assignments should be reversed, and that nu4 has not been properly identified. Author (TAB)

N68-33002# Du Pont de Nemours /E. I./ and Co., Aiken, S. C. Savannah River Lab.
ROUTINE ISOTOPIC ANALYSIS OF LITHIUM IN Li-Al ALLOY BY ATOMIC ABSORPTION SPECTROMETRY
J. Allen Wheat 13 Sep. 1967 10 p Presented at 11th Conf. on Anal. Chem. in Nucl. Technol., Gatlinburg, Tenn., 10–12 Oct. 1967
(Contract AT(07-2)-1)
(DP-MS-67-62; Conf-671012-7) CFSTI: HC$3.00/MF$0.65

The method simultaneously determines the isotopic composition and the molar concentration of lithium. Aluminum in concentrations up to 200 times that of the lithium in acid solutions of the alloy did not interfere with the atomic absorbance measurements. The basis for the atomic-absorption method is the isotope shift in the absorption spectra for ^6Li and ^7Li. Two absorption lines of ^6Li and two of ^7Li occur in a 0.30 Å region of the spectrum at 6708 Å; the stronger ^6Li line is superimposed on the weaker ^7Li line. The two absorption lines of each isotope are separated by 0.15 Å, and the shift between isotopes is also 0.15 Å. The ratio of the atomic absorbances of a lithium solution measured with two emission sources containing different atom ratios of ^6Li and ^7Li was related to the isotopic composition of the lithium in the solution. Since the absorption by neither lithium isotope strictly obeyed Beer's Law, the measured absorbance ratios of lithium solutions varied not only with isotopic composition but also to some extent with concentration. The minimum departure from Beer's Law was between 4.3×10^{-4} and 5.7×10^{-4}M total lithium. In this range, and for isotopic compositions of ^6Li between 7 and 88%, the relative precision of the isotopic analysis was 1.8%. Author (NSA)

N68-33012# National Academy of Sciences–National Research Council, Washington, D. C.
USERS' GUIDES FOR RADIOACTIVITY STANDARDS
B. Kahn, G. R. Choppin, and J. G. V. Taylor Oct 1967 43 p refs
(NP-17502) CFSTI: HC$3.00/MF$0.65

Chemical and counting problems for radioactivity standards in common use or expected to be available are presented. The guides are prepared separately for every element. Guides are presented for Na, Mg, P, K, Ca, Cr, Fe, Co, Zn Ga, As, Br, Kr, Sr, Y, Zr, Nb, Ru, Rh, Ag, Sn, Sb, Te, I, Cs, Ba, rare earths, Ir, Au, Hg, Tl, Po, Rn, Ra, Th, U, Np, and Am. NSA

N68-33017# Institute of Modern Languages, Inc. Washington, D. C. Translation and Interpretation Div.
PHYSICO-CHEMICAL PRINCIPLES FOR APPLYING LIMINOPHORES TO SCREENS BY THE SETTLING METHOD[NEKOTORE FISIKO-KHIMICHESKE OSNOVY NANESENIYA LUMINOFOROU NA EKRANY METODOM OSADZENIYA]
L. A. Saminsky Ft. Belvoir, Va. Army Engr. Res. and Develop. Labs. Jun. 1968 20 p refs Transl. into ENGLISH from Proc. of 5th Congr. on Luminophores (Tartu), Jun. 1956 p 326–337
(Contract DAAK02-68-C-0396)
(ERDL-T-1928-68; AD-671702)

The colloidal-chemical processes which determine the structure and resolution capability of the screen, and the strength and speed of its adhesion to the glass in the presence of a liquid phase have decisive importance. The structure of the screen depends on the aggregative stability of the luminophore in its suspension. Adhesion of the luminophore to the glass in the presence of a liquid phase depends on the strength of the electrostatic forces of repulsion between the glass and the luminophore. Strong adhesion with high aggregative stability of a luminophore can be obtained due to chemical changes in solution. Electrostatic effects do not have a decisive influence in a calcium silicate solution on adhesion of luminophore to glass. The strength of adhesion of the screen in the presence of a liquid is determined mainly by the degree and condition of silicic acid polymerization. Author

N68-33026# Aerospace Corp., El Segundo, Calif. Lab. Operations.
X-RAY FLUORESCENCE ANALYSIS FOR HAFNIUM AND ZIRCONIUM IN MIXTURES OF THEIR CHLORIDES, CARBIDES, AND OXIDES
J. H. Richardson Mar. 1968 17 p refs
(Contract F04695-67-C-0158)
(TR-0158(3250-10)-12; SAMSO-TR-68-221; AD-671926)

An x-ray fluorescence technique for analyses of mixtures of hafnium and zirconium oxides is described. The basic procedures are extended to include mixed carbides and mixed chlorides. The use of the silicon (111) spectrometer crystal effectively eliminates the usual interference of the second-order zirconium K spectrum with the first-order hafnium L spectrum. Good accuracy and precision are obtained in the range from 0.5 to 99.5 wt % ZrO_2. Author (TAB)

N68-33041# Atomic Energy Commission Research Establishment, Lucas Heights (Australia).
STUDIES IN COMPUTER COUPLED RADIOCHEMICAL ANALYSIS. Part 1. PEAK LOCATION AND PEAK ENERGY MEASUREMENT IN SCINTILLATION SPECTROMETRY
A. R. Palmer Feb. 1968 26 p refs
(AAEC/TM-437)

A FORTRAN IV (Level H) program is described, which locates photopeaks in the output of a multichannel analyzer scintillation spectrometer assembly. The program is particularly useful for processing the output of large-capacity analyzers working in conjunction with a high-resolution Ge(Li) detector. Author (NSA)

N68-33045 California Univ., Davis.
STEREOCHEMISTRY OF ASYMMETRIC SILICON: A STUDY OF THE SILICON-NITROGEN BOND

Joel David Citron (Ph.D. Thesis) 1967 103 p
Available from Univ. Microfilms: HC $5.20/MF $3.00 Order No. 67-14968

Several optically active silylamines containing the α-NpPhMeSi-system were prepared, and their relative and absolute configurations were determined. Extensive studies of the dynamic (reaction) stereochemistry of the cleavage reactions of the silicon-nitrogen bond with diverse reagents showed that inversion of configuration is the most common (but not the exclusive) stereochemical path for such reactions. With various Lewis acids, such as BF_3 and HCl, the predominant stereochemical course is inversion. These are believed to proceed via an S_N2–Si mechanism, since initial coordination of the nitrogen moiety with the acid generates a good leaving group. Several exceptions to this general pattern of inversion of configuration were found, the most notable of these being the reaction of benzoic acid with $R_3Si^+NH_2$. This is the only known example of retention of configuration in a reaction with a protic acid, and it also involves the only clear case of change in stereochemistry at asymmetric silicon because of steric effects. Dissert. Abstr.

N68-33047 National Lending Library for Science and Technology, Boston Spa (England).
ADSORPTION INTERACTION OF SURFACE-ACTIVE SUBSTANCES AND POLYMERS WITH TITANIUM DIOXIDE [ADSORBTSIONNOE VZAIMODEISTVIE POVERKHNOSTNO-AKTIVNIJKH VESHCHESTV I POLIMERA S DVUOKIS'YU TITANA]
S. N. Tolstaya, S. S. Mikhailova, A. B. Taubman, and A. V. Uvarov Jun. 1968 12 p refs Transl. into ENGLISH from Lakokrasochnye Materialy i ikh Primenenie (Leningrad), no. 6, 1967 p 8–12
(RTS-4647) Available from Natl. Lending Library, Boston Spa, Engl.: 12s 6d

Details are given on a experiment to examine the modification of titanium dioxide due to the adsorption of surface substances (SAS) and binders. The influence of the heterogenity of the surface, and the character of the interaction of surface active agents and binder in their joint adsorption were examined. Rutile and anatase forms of titanium dioxide were used for the investigation in which the adsorption of various substances such as stearic acid and polyvinly chloride resin on TiO_2 was measured. Tabulated data obtained for infrared spectroscopy are given on maximum adsorption of SAS on rutile and anatase. Results show that long chain amines and fatty acids are partially chemically and irreversibly adsorbed on the surface of TiO_2 and are capable of excluding chlorinated polyvinyl chloride from the surface. B.S.D.

N68-33073 Montana State Univ., Missoula.
STRUCTURAL STUDIES OF ORGANIC TITANIUM COMPOUNDS
Keith Donald Watenpaugh (Ph.D. Thesis) 1967 97 p
Available from Univ. Microfilms: HC $5.00/MF $3.00 Order No. 67-13588

Using the Symbolic Addition Procedure the structures of three organic compounds of titanium are solved by X-ray diffraction. Dichlorodiphenoxytitanium (IV) crystallizes in space group $p2_1/n$ with $a = 9.82$A, $b = 14.01$A, $c = 9.84$, $\beta = 94°50'$. The compound is dimerically located around the center of symmetry, the two titaniums being joined with oxygen bridges, each titanium being penta coordinated in the form of a trigonal bipyramid. The first hydrolysis product of tetraethoxytitanium (IV) crystallizes in space group $P2_1/a$ with $a = 27.99$A, $b = 22.42$A, $c = 23.21$A, $\beta = 117°15'$. Chemical analysis and density measurements indicate the compound to have the empirical formula $Ti_7O_{24}(C_2H_5)_{19}$ with 8 molecules per unit cell. The compound is made up of TiO_6 octahedra sharing edges. Bonds from oxygen atoms to neighboring titanium atoms varies from one to four. Due to the complexity of the compound, all the carbon atoms could not be located. Dissert. Abstr.

N68-33079# Oak Ridge National Lab., Tenn.
THE PROCESSING OF THORIUM OXIDE AND URANIUM OXIDE SOL-GEL MATERIALS
C. F. Weaver, D. N. Hess, H. F. McDuffie, W. T. Rainey, and S. A. Soldano Jun. 1968 60 p refs
(Contract W-7405-ENG-26)
(ORNL-TM-1809) CFSTI: HC $3.00/MF $0.65

ThO_2–UO_2 (3 mole %) gels when heated gave off gases the quantity and nature of which depended strongly on particle size. The reversible adsorption of CO_2 on finely divided gel was studied over the temperature range from 250 to 1000°C. A method was developed to reduce the surface area of the gel and, thus, reduce the amount of gas that it could release in service. The sol-gel ThO_2 microspheres also yielded gases on heating. The largest amount of gas evolution occurred in the following centigrade temperature intervals: (240 to 260), (400 to 460), and (700 to 760). Organics were essentially eliminated at 260°C, and most of the gas was either CO_2, Co, or H_2. Attention was then turned to UO_{2+x} sol-gel microspheres. It was found that H_2O vapor carried by an inert gas (He or Ar) was very effective in the removal of the carbonaceous materials, that their removal was essentially complete at 550°C, and that this removal could be monitored with a hydrocarbon analyser. Reduction of O/U ratio to two was accomplished with H_2 in the temperature range 550 to 1000°C. One hour at 850°C was found to be sufficient. Author (NSA)

N68-33149# Mound Lab., Miamisburg, Ohio.
THE DEPOSITION OF MOLYBDENUM ON ZrO_2 AND UO_2 SPHERES FROM THE GAS PHASE
H. Schneider and D. Schonwald [1968] 28 p refs Transl. into ENGLISH from Rept. KFK-555
(Contract AT (33-1)-GEN-53)
(MLM-1506(TR)) CFSTI: HC $3.00/MF $0.65

The deposition of metallic molybdenum from the gas phase by reduction of molybdenum pentachloride was considered for the coating of UO_2 spheres. In the course of the first experiments with zirconium oxide spheres, it was ascertained that $MoCl_5$ not supplied in ampules is very strongly contaminated with oxygen and must be freshly sublimed before each experiment. The process course was next tried on small charges of zirconium oxide spheres, whereby up to 25 weight-% of Mo was put on, and then carried over to uranium dioxide spheres. By this, up to 21 weight-% of Mo was vapor-deposited with charges of 100 g UO_2. The process technique was improved so far until 100 g UO_2 charges were able to be provided with pure molybdenum coatings with certainty and good yield. The surface quality of the molybdenum deposited was judged visually under a microscope, its purity established with the aid of chemical and X-ray diffraction methods. To the parameters concerning coating quality and yield, particular consideration was given to the vaporization rate and gas velocity. Author (NSA)

N68-33166# Kernforschungszentrum, Karlsruhe (West Germany).
THE INFLUENCE OF ORGAINC HALIDES ON THE HYDROGEN YIELD FROM THE GAMMA RADIOLYSIS OF METHANOL [DER EINFLUSS VON ORGANISCHEN HALOGENIDEN AUF DIE AUSBEUTE AN WASSERSTOFF BEI DER GAMMA-RADIOLYSE VON METHANOL]
Haruko Matsuoka, K. Sato, T. Masuda, and M. Kondo [1967] 12 p refs Transl. into GERMAN from Nippon Kagaku Zasshi (Tokyo), v. 87, 1967 p 1320–1322 In GERMAN
(KFK-TR-238) JCL: HC $1.10/MF $0.80

Kinetic studies on the effect of CCl_4, C_6H_5Cl, and p-$C_6H_4Cl_2$ on radiolytic yield of hydrogen from methanol showed that the G - value for solvated electrons as a precursor of hydrogen was 2.0. The yield of hydrogen from methanol in the presence of sulfuric acid and that of chloride ion in the presence of halides gave evidence of slovated electrons which can be scavenged by solutes but form on hydrogen and the G-value of which is determined as approximately 0.6. Author (NSA)

N68-33192# Oklahoma Univ., Norman. Coll. of Engineering.
METHOD FOR THE CONTROLLED ADDITION OF OXYGEN TO COLUMBIUM
James D. Gerber, Frank E. Rizzo, and Raymond D. Daniels May 1968 25 p refs
(Contract AT(40-1)-2570)
(ORO-2570-12) CFSTI: HC $3.00/MF $0.65

A technique for making additions of small amounts of oxygen to Nb is presented. The technique involves complete reduction of a carefully weighed metal–metal oxide mixture by the Nb in a sealed evacuated chamber at 900°C. The oxygen pressure in equilibrium with the metal–metal oxide mixture was found to be quite critical. Large oxygen pressures resulted in severe surface oxidation while low oxygen pressures did not permit reduction in a reasonable amount of time. Using iron-wustite (Fe_xO) mixtures, controlled additions of 15 to 300 ppM oxygen were made to Nb. The technique makes possible oxygen additions within 4 ppM of the desired composition. Author (NSA)

N68-33193# National Lead Co. of Ohio, Cincinnati.
URANIUM TETRAFLUORIDE URANIUM DIOXIDE BINARY SYSTEM
L. A. Khripin and L. A. Lukyanova Sep. 1967 6 p refs Transl. into ENGLISH from Izv. Sibirsk. Otd. Akad. Nauk SSSR. Ser. Khim. Nauk (Novosibirsk), no. 1, 1966 p 131–133
(NLCO-TR-9) CFSTI: HC $3.00/MF $0.65

In a study of the UF_4–UO_2 system the UF_4 used was separated from its UO_2F_2 and UO_2 impurities by vacuum distillation under residual pressure of the order of 10^{-4} mm Hg at 1000°C. Tests were made with the wt % UO_2 varying from 0 to 72.5%. The system was studied by differential thermal analysis. A phase diagram was constructed based on the data. The results indicated that the melting point of UF_4 changed comparatively little when the content of uranium dioxide did not exceed about 10%. With the presence in the mixture of up to 20% UO_2 the melting point was lowered by almost 60°C, which does not confirm earlier literature data. It was established that this system (up to 75% UO_2) belongs to the simple eutectic type. The eutectic corresponds to a temperature of 920°C and a composition with 24.5 wt % UO_2. The results are compared with existing literature data. NSA

N68-33239*# Notre Dame Univ., Ind. Dept. of Chemistry.
POLYMERIC SCHIFF BASES. 17: AZOMETHINE COPOLYMERS
G. F. D'Alelio, W. F. Strazik, D. M. Feigl (St. Mary's Coll., Notre Dame, Ind.), and R. K. Schoenig [1968] 37 p refs
(Grants NGL-15-004-001; NGR-15-004-028)
(NASA-CR-96370) CFSTI: HC $3.00/MF $0.65 CSCL 07C

Tractable azomethine copolymers are difficult to prepare by solution processes. Melt polymerization techniques have been used to synthesize random, block and graft azomethine copolymers in which the repeating units correspond to units derived from either A-B monomers or a pair of A-A and B-B monomers. Not all systems yielded tractable copolymers, and these limitations are discussed. The block copolymers are prepared readily by the reaction of appropriate insoluble oligomers with monomers, or by the reaction of two different fusible oligomers. The thermal stabilities of the copolymers are high and comparable to azomethine homopolymers. Author

N68-33264# Idaho Nuclear Corp., Idaho Falls.
DESCRIPTION OF THE PILOT PLANT FOR THE HEADEND REPROCESSING OF UNIRRADIATED ROVER FUELS
D. C. Kilian, A. P. Roeh, and B. R. Dickey May 1968 19 p refs
(Contract AT(10-1)-1230)
(IN-1181) CFSTI: HC $3.00/MF $0.65

A nonradioactive pilot plant facility for the headend processing of graphite-matrix nuclear rocket (Rover) fuel is described. The graphite matrix is removed by burning in an inert alumina bed fluidized with oxygen; the uranium is converted to the nonvolatile oxide, U_3O_8, and separated from the bed by elutriation from the burner. Solids scrubbed from the off-gas are dissolved in nitric acid, producing a solution suitable for solvent extraction of the uranium. Author (NSA)

N68-33315# Bureau of Mines, College Park, Md.
CHLORINE DISSOLUTION OF SEVERAL FERROALLOYS
D. H. Chambers, P. M. Sullivan, and L. L. Kupper Sep. 1968 17 p refs
(BM-RI-7178)

Digestion studies were undertaken to develop a method for the rapid dissolution of high-temperature ferroalloy scrap. Laboratory tests showed: (1) dissolution of alloy scrap with ferric ion as the leaching agent was a moderately rapid method of digestion; (2) the dissolution process can be considered as a typical reaction of a metal with chlorine gas, although evidence was obtained to show dissolution as a two-step process, one step as the reduction of ferric ion by the soluble alloy constituents and the other as the oxidation of ferrous ion with chlorine gas; and (3) the attack of ferric ion on the alloy was a function of alloy composition, ferric to ferrous ion ratio, and area of contact between leach solution and alloy. The exceedingly complex nature of alloy compositions and dissolution products generally precluded satisfactory analytical determinations. Results of moderate accuracy were obtained using complex modifications of standard analytical and spectrographic techniques. Author

N68-33319# Michigan Univ., Ann Arbor.
HYPERFINE STRUCTURE CONSTANTS OF SODIUM IODIDE
Carl Elmer Miller (Ph.D. Thesis) 1967 114 p refs
(Contract AT(11-1)-1112)
(COO-1112-163) CFSTI: HC $3.00/MF $0.65

A molecular-beam electric-resonance spectrometer was constructed and used to study the radiofrequency spectrum of $^{23}Na^{127}I$ for transitions between the hfs levels of the first rotational state. Transitions for the first four vibrational states were observed in near-zero electric and magnetic fields and the spectral lines were found to exhibit a natural line width of 2.5 kHz. All the constants necessary to describe the molecule with the $^1\Sigma$ hfs Hamiltonian were determined from the observed rf spectrum; this was not done previously for a heteronuclear, diatomic molecule in which both nuclei have quadrupole moments. Within the accuracy of the measurements, the magnetic coupling constants were found to be independent of the particular vibrational state with a maximum change for each vibrational state of ±0.06 kHz. Author (NSA)

N68-33322 Louisiana State Univ., Baton Rouge.
SPECTRAL STUDIES OF SELECTED OXOVANADIUM (IV) COMPLEXES
Gerald John Maus (Ph.D. Thesis) 1967 90 p
Available from Univ. Microfilms: HC $4.80/MF $3.00 Order No. 67-13998

A great deal of interest has been generated in oxovanadium (IV) chemistry in the last several years. There are several reasons for the interest in this species. Oxovanadium (IV) possesses great stability, is capable of existing in solid, liquid and in vapor phases without destruction of the VO^{2+} entity, and it is a central molecule-ion and may therefore be studied by methods not applicable to the usual central atom-ions. Another reason for the interest in this species is that oxovanadium(IV) usually has square base pyramid geometry in complexes with bidentate ligands. This geometry is quite rare among the first row transition elements. Perhaps the main reason for the recent interest in oxovanadium(IV) is that it is a d^1 electronic species and should lend itself to an easy theoretical

interpretation. Much of the recent work, in fact, has been to elucidate a theoretical scheme to account for the observed electronic transitions. Dissert. Abstr.

N68-33373 Washington State Univ., Pullman.
THE SURFACE INTERACTION OF NITROGEN AND RHENIUM
David William Kammer (Ph.D. Thesis) 1967 73 p
Available from Univ. Microfilms: HC $4.00/MF $3.00 Order No. 67-15751

The interaction between a polycrystalline rhenium filament and nitrogen gas in the temperature range from 290 to 2100°K has been investigated. Highly time dependent pumping rates were observed above 1800°K, and shown to be caused by atomization, compound formation, and dissolution of nitrogen into the bulk of the filament. The compound ReN was observed directly with a mass spectrometer, while the diffusion coefficient of nitrogen through rhenium was found to be 1×10^{-10} cm^2/sec. Sticking probability vs surface coverage curves for several adsorption temperatures are given along with desorption spectra for various initial coverages. It is shown that nitrogen adsorbs on rhenium in at least two high energy states and that the sticking probability for nitrogen on rhenium is about one order of magnitude less than that for nitrogen on tungsten under comparable conditions, while saturation coverage is about half that for nitrogen on tungsten. Dissert. Abstr.

N68-33378*# Battelle Memorial Inst., Columbus, Ohio.
DEVELOPMENT OF CHEMICAL ANALYSIS TECHNIQUES FOR ADVANCED MATERIALS Final Report, 17 Jan. 1967–16 Jul. 1968
E. R. Blosser 14 Aug. 1968 74 p Prepared for JPL
(Contracts NAS7-100; JPL-951578)
(NASA-CR-96385) CFSTI: HC $3.00/MF $0.65 CSCL 07D

Techniques have been developed to determine all elemental impurities in magnesium oxide and, to a limited extent, impurities in several other compounds. By combining data obtained by use of the mass and optical emission spectrographs, wet chemistry, and combustion and thermal chemistry, every element either has been determined at levels ranging from subparts per million to many percent or found not to be present. One particularly troublesome determination, that of hydroxyl in MgO, has been solved by the use of an oxygen atmosphere and heat. In appendixes the experimental details of this work are given, as well as tabulations of the data generated during the program. Author

N68-33379 George Washington Univ., Washington, D. C.
GOLD–CHLORINE AND GOLD–BROMINE EQUILIBRIA IN MOLTEN ALKALI HALIDES
David Edward Icenhower (Ph.D. Thesis) 1967 105 p
Available from Univ. Microfilms: HC $5.20/MF $3.00 Order No. 67-14401

The reaction of gold and chlorine in molten equimolar NaCl–KCl has been found to be very complex. In fact, determination of thermodynamic quantities would be difficult by ordinary methods such as electrochemical and cryoscopic studies because of the variable valence of gold. The mole fraction X of AuCl was calculated on the basis of two assumptions. The first is that Au(I) is present almost entirely as the simple positive ion. The second is that Au(III) is present mainly as the $AuCl_4$ ion, which forms ideal solutions with the melt at concentrations below about 2 percent. The mole fractions of AuCl in equilibrium with metallic gold and 3 partial pressures of chlorine were determined by chemical analysis of samples from the melt. The vapor over the melt was analyzed and contained approximately equal moles of Au, Na, and K as the chlorides with a total vapor pressure of about 15 torr in a chlorine atmosphere at 1,300°K. Dissert. Abstr.

N68-33390 Rochester Univ., N. Y.
ASPECTS OF CHEMICAL REACTION IN GASES
William Edward Smyser (Ph.D. Thesis) 1967 138 p
Available from Univ. Microfilms: HC $6.60/MF $3.00 Order No. 67-13649

Preliminary calculations were made to determine whether the rate of reaction of chlorine atoms, produced by flash photolysis, with nitryl chloride could be measured. Previous investigations place the desired rate constant between 10^4 and 10^{11} l^2/mole^{2}sec. The flash duration of lamps which deliver enough light to produce measurable amounts of products limits the measurable rates to those with a rate constant below 10^9 l^2/mole^{2}sec. The rate can be measured directly by following the change in the light from a continuous source absorbed by the nitrogen dioxide produced. If the rate constant is near 10^4 l^2/mole^{2}sec, atom recombination may be as important in removing chlorine atoms as the reaction with nitryl chloride; their relative rate is determined from the final concentration of nitrogen dioxide produced for different initial chlorine atom concentrations and different total pressures. This gives the rate constant for the nitryl chloride–chlorine atom reaction since the recombination rate constant is known. Dissert. Abstr.

N68-33420 Missouri Univ., Columbia.
QUANTITATIVE DETERMINATION OF AMINO ACIDS BY GAS-LIQUID CHROMATOGRAPHY N-TRIFLUORO ACETYL n-BUTYL ESTERS
David Laurence Stalling (Ph.D. Thesis) 1967 119 p
Available from Univ. Microfilms: HC $5.80/MF $3.00 Order No. 67-13869

The objectives of this study were to develop and evaluate a procedure which would give quantitative conversion of all twenty natural protein amino acids to their N-trifluoroacetyl *n*-butyl esters. Pure derivatives for use as reference standards were prepared and employed to determine the percent conversion of the amino acids in an analytical procedure. Application of the developed analytical method to the analysis of synthetic amino acid mixtures and several different protein hydrolysates gave excellent agreement (within one percent absolute for total amino acids present) with ion-exchange chromatographic analyses. This data conclusively demonstrates that quantitative analysis of amino acids by gas-liquid chromatography can be achieved rapidly and accurately. This procedure will strongly support and advance studies in genetics, protein biochemistry, agricultural sciences, medical research and nutrition, as well as in space related research. Dissert. Abstr.

N68-33427*# National Bureau of Standards, Washington, D. C.
A SURVEY OF THERMODYNAMIC PROPERTIES OF THE COMPOUNDS OF THE ELEMENT CHNOPS Progress Report, 1 Mar.–30 Jun. 1968
George T. Furukawa, Martin L. Reilly, and Eugene S. Domalski
22 Jul. 1968 51 p refs
(NASA Order R-138)
(NASA-CR-96468; NBS-9883; Rept.-14) CFSTI: HC $3.00/MF $0.65 CSCL 07D

Tables of thermodynamic properties are calculated for twelve additional substances in their ideal-gas state using statistical methods. The molecular constants and the spectroscopic data used for the substances are those given in the JANAF tables. The value used for the gas constant R is 8.3143/4.1840 cal/K-mol. The 1961 atomic weights based on C-12 were used in the calculations. Selected heats of combustion and heats of formation of organic compounds of biological interest are included. Author

N68-33441# Chemical Lab. RVO-TNO, Rijswijk (Netherlands).
THE USE OF SEMI-MICRO TECHNIQUES IN INFRARED SPECTROSCOPY [HET GEBRUIK VAN SEMI-MICRO TECHNIEKEN BIJ INFRAROOD-SPECTROSCOPIE]
F. H. Meppelder Mar. 1968 22 p refs
(TDCK-50904; Rept.-1968-1) CFSTI: HC $3.00/MF $0.65

The application of infrared spectroscopy to the identification of chromatographic samples was studied. Chromatographic techniques, when used on an analytical scale usually give such small samples that normal infrared equipment and experimental procedures cannot be used. For this purpose a special minimum volume liquid cell was designed. For solids and nonvolatile liquids, the application of lead reducing rings proved to be useful. With both tools good spectra with standard optical density of samples in the 50–150 μg range were obtained. These spectra were obtained without additional equipment or the use of special scanning conditions. The sensitivity is sufficient for most of the problems encountered in the laboratory. A sensitivity which is 10 to 100 times higher can ultimately be reached but only at the expense of much effort and with the use of expensive accessories. At this level one is approaching the so-called chemical noise level. Author

N68-33467 Johns Hopkins Univ., Baltimore, Md.
STABILITY RELATIONS OF MINERALS IN THE SYSTEM Mn–Si–C–O
J. Stephen Huebner (Ph.D. Thesis) 1967 298 p
Available from Univ. Microfilms: HC $13.50/MF $3.85 Order No. 67-13806

Many metamorphic ore bodies have compositions that plot within the system $MnO–SiO_2–C–O_2$. Observed phase assemblages and reactions agree with the graphic analysis. A petrogenetic grid can be constructed with the reactions between the common manganese oxides, silicates, and carbonate. Natural mineral assemblages cannot be explained solely by the "metamorphic grade" of the adjacent country rocks; the necessary parameters are temperature, pressure, and the fugacities of oxygen and carbon dioxide. The rhodochrosite stability field is bounded by reactions with vapor to form manganosite + graphite, manganosite, hausmannite, partridgeite, and pyrolusite. The addition of SiO_2 limits the rhodochrosite field by reaction to form rhodonite and tephroite. At high fo_2 braunite forms from rhodochrosite + quartz, cutting between the rhodochrosite-quartz field and the hausmannite-partridgeite buffer. Dissert. Abstr.

N68-33470 Ohio State Univ., Columbus.
INFRARED SPECTRA OF $^{15}N_2O^{18}$ AND $^{15}NO^{18}$
James Lee Griggs, Jr. (Ph.D. Thesis) 1967 144 p
Available from Univ. Microfilms: HC $6.80/MF $3.00 Order No. 67-16281

The study of high-resolution infrared spectra of molecules is one of the most effective means of obtaining precise values for internuclear distances and other molecular structural parameters. Also, these studies enable one to obtain the potential energy functions applicable to molecules, based upon vibrational energy levels which are determined with high accuracy from analysis of infrared data. With the current availability of isotopically enriched samples of various molecular species, unambiguous determinations of molecular structure is possible. The present work describes an extensive absorption study of the rare isotopic species of nitrous oxide, $^{15}N_2{}^{18}O$, and of nitric oxide, $^{15}N^{18}O$. Dissert. Abstr.

N68-33476 Johns Hopkins Univ., Baltimore, Md.
HD-RARE GAS DISSOCIATION REACTIONS
Richard Walter Rozett (Ph.D. Thesis) 1967 127 p
Available from Univ. Microfilms: HC $6.20/MF $3.00 Order No. 67-13826

Experiments were performed on a tandem mass spectrometer over an energy range of 2 to 50 eV for hydrogen and helium reactions. Absolute cross sections and isotope ratios were measured for the ion-neutral dissociation reactions of the hydrogen–rare gas system. All the cross sections were below 5 Å². An interesting result is the difference between the isotope ratio for the helium reactions. The D+/H+ ratio for the former reaction shows periodic maxima, and is always greater than one. The latter increases monotonically with energy from considerably less than one at low energies to considerably more than one at high energies. The results are interpreted in terms of the complex, spectator, displacement and rebound mechanisms as well as the help of the charge exchange and field dissociation process. Dissert. Abstr.

N68-33496 Florida Univ., Gainesville.
THE THEORY AND APPLICATION OF A CONTINUOUS SOURCE IN ATOMIC ABSORPTION FLAME SPECTROMETRY
William Walter McGee, III (Ph.D. Thesis) 1966 89 p
Available from Univ. Microfilms: HC $4.60/MF $3.00 Order No. 67-13152

The aims of this dissertation were two-fold: (1) establish the mathematical relationship between signal measured and solution concentration when using a continuous source; and (2) continue the development of the quantitative aspects of atomic absorption flame spectrometry using a continuous source of radiation. Because of the basic differences between the absorption signal measured when using a line and a continuous source, this investigation was carried out to determine if a more accurate and useful relationship (than absorbance) between the absorption and sample concentration existed when using a continuous source. An experimental set-up for the trace measurement of twenty-one elements is described. The components are chosen for this system to insure maximum versatility without sacrificing sensitivity. The heart of this system is a continuous source, total consumption aspirator burner, an extended flame cell, and an argon/hydrogen-entrained air flame, and a medium resolution, large aperture monochromator. Dissert. Abstr.

N68-33515*# Notre Dame Univ., Ind. Dept. of Chemistry.
THE DIRECT SYNTHESIS OF CROSSLINKED POLYMERIC AZOMETHINES
G. F. D'Alelio, D. M. Feigl, H. E. Kieffer, and R. K. Mehta [1968] 2 p Presented at the Symp. on Polymers in Space Res., Pasadena, Calif., 15–17 Jul. 1968
(Grant NsG-339)
(NASA-CR-96367) CFSTI: HC $3.00/MF $0.65 CSCL 11I

Polymeric azomethines were studied to determine changes that would result in char yields by introducing crosslinks into the compounds. A polyketanil was selected as the linear reference polymer, and two series of H400 polymers with crosslink density values between zero and one were prepared by melt condensation under nitrogen at atmospheric pressure for 2 hr at 180°C, 2 hr at 225°C, 17 hr at 325°C, and 2 1/2 hr at 400°C. Yields from the uncatalyzed reactions were found to increase with an increase in the amount of trifunctional crosslinking. These yields, however, were lower than those obtained from zinc chloride catalyzed reactions. Yields of the catalyzed reaction also increased with an increase in catalyst concentration. Char yields of polymers with crosslink density greater than zero were higher than those with zero density. Portions of the H400 polymers were postheated under nitrogen for 20 min at 600°C, and the resulting polymers designated H600 had char yields as high as 88% at 1176°C; the H400 yields at this temperature were 67% and 75%, depending on crosslink density. M.W.R.

N68-33522 Rochester Univ., N. Y.
THE EFFECT OF AXIAL MIXING ON THE CONVERSION OF A SECOND ORDER, ISOTHERMAL CHEMICAL REACTION IN A PACKED BED
John Edward McWharf (Ph.D. Thesis) 1967 346 p
Available from Univ. Microfilms: HC $15.75/MF $4.45 Order No. 67-13835

The rate constant of the isothermal, second-order methyl acetate saponification reaction was determined in a batch system at 25°C by following the electrical conductivity of the reacting

solution. The average of five experimental runs was 1925 ±.003 ./g.mol. sec. Residence time distributions (RTD's) in a fixed bed reactor were measured by means of a pulse input technique. Point electrical conductivity measurements were made at five radial positions at the entrance and exit of the bed. The study covered a range of Reynolds numbers in the laminar and transition regions in a two-inch diameter column, three feet long, which was packed with glass beads 2.1, 3.1, and 6.1 mm. in diameter. Dissert. Abstr.

N68-33561 Harvard Univ., Cambridge, Mass.
ONE: NUCLEAR MAGNETIC RESONANCE STUDIES. TWO: STUDY OF IONIC COLLISION PROCESSES BY ION CYCLOTRON DOUBLE RESONANCE SPECTROSCOPY
Leslie Reiff Anders (Ph.D. Thesis) 1967 122 p
Available from Univ. Microfilms: HC $6.00/MF $3.00 Order No. 67-11252

Nuclear magnetic resonance experiments were performed on a gaseous mixture of HD and CO_2. The application of the density matrix theory of double resonance to the analysis of the spectra indicates that a strong-collision model describes the system more accurately than a weak-collision model. A new experimental technique, ion cyclotron double resonance spectroscopy, is developed and applied to the study of gas phase ionic collision processes and ion-molecule reactions. The theory of ionic collision processes and its application to ion cyclotron double resonance experiments is developed from the Boltzmann transport equation. The theoretical and experimental results for a double resonance experiment on a mixture of ^3He and ^4He are in agreement. Experiments involving ion-molecule reactions of chemical interest are described in which this technique is used to describe the relationship between the various reactant and product ions. Dissert. Abstr.

N68-33607 National Lending Library for Science and Technology, Boston Spa (England).
INVESTIGATION OF THE STRUCTURAL MECHANICAL PROPERTIES OF AQUEOUS DISPERSIONS OF TITANIUM DIOXIDE [ISSLEDOVANIE STRUKTURNO-MEKHANICHESKIKH SVOISTV GIDRODISPERSII DVUOKISI TITANA]
E. M. Aleksandrova, M. G. Sakharova, and V. L. Maksimov Apr. 1968 12 p refs Transl. into ENGLISH from Lakokrasochnye Materialy i Ikh Primenenie (Leningrad), no. 4, 1967 p 58–61
(RTS-4459) Available from Natl. Lending Library, Boston Spa, Engl.: 10s

The effects of surface-active substances on the degree of hydrophilic capacity of titanium dioxide pigment were studied to determine aggregate stability and structural mechanical properties of pigment dispersions in water. Examined were the modifying actions of the following agents: cation-active (VA-10 and VA-2), anion-active (sodium oleate, KMTs, peptising agent NF), and non-ionic (OP-10). Dialysed and undialysed TiO_2 powders were tested using rheological methods as follows: (1) by the value of the plastic strength ultimate shear stress of the coagulation structure, and (2) by the displacement of a plate in suspensions of TiO_2. A special device which was developed for determining the structure-mechanical properties of suspensions is described. Results indicate that structure-mechanical properties and consequently aggregative stability of dialysed and undialyzed powders are determined not only by the concentration of the surface reactive agent, but also by the presence of extraneous ions on the surface of the absorbent. S.C.W.

07 COMMUNICATIONS

Includes communications equipment and techniques, noise; radio and communications blackout; modulation telemetry; tracking radar and optical observation; and wave propagation. For basic research see: 23 Physics, General; and 21 Navigation.

N68-32297# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ON NOISE IMMUNITY OF BINARY-DECIMAL CODES [O POMEKHOUSTOYCHIVOSTI DVOICHNO-DESYATICHNYKH KODOV]
V. V. Efimenko Nov. 1967 13 p refs Transl. into ENGLISH from Avtometriya (USSR), no. 2, 1965 p 63–68
(FTD-MT-24-312-67; AD-671872)

Questions are discussed which are connected with the analysis of noise immunity of binary decimal codes during their use in digital measuring instruments. The selection of a quantitative measure of noise immunity is discussed. Noise immunity of binary-decimal codes is studied and a model of a monodecade digital instrument under the influence of short duration additive pulse interferences. The resistance of binary-decimal codes to additive pulse interferences of short duration was examined, inasmuch as the literature on the subject appears to be contradictory. A quantitative characteristic of interference-free properties of binary-decimal codes is suggested; it takes into account the degree of mismatch of coding results with respect to the real value of the measured magnitude, as well as the probability of occurrence of this mismatch. Interferences of two kinds were considered: first-order (directly affecting the measured input value), and second-order (acting upon individual components and producing malfunctions). TAB

N68-32349# Innsbruck Univ. (Austria).
SOME PROPERTIES OF HELICAL ANTENNAS AT LOW FREQUENCIES Scientific Report, Mar. 1967–Jan. 1968
Rafael Lukavec and Tilman Elster 20 Apr. 1968 41 p refs
(Contract AF 61(052)-902)
(AFCRL-68-0345; SR-6; AD-671971)

Experimental examination and results of self-resonant helical antennas in the frequency range between 25 kc and several Mc/sec are described. The dimensions of these antennas are several orders of magnitude smaller than the wavelength in the surrounding medium. The influences of two different media surrounding the antenna, namely air and water, on the input impedance and resonant frequency of the antennas are described. The electrical properties of water were studied separately. It is shown how to obtain the quantities of a network model for describing such antennas, from the measured data. Author (TAB)

N68-32351*# California Univ., Berkeley. Space Sciences Lab.
THE RATE DISTORTION FUNCTION FOR A CLASS OF SOURCES
David J. Sakrison 22 Jul. 1968 41 p refs *Its* Ser. B, Issue No. 35
(Grant NGR-05-003-143)
(NASA-CR-96200) CFSTI: HC $3.00/MF $0.65 CSCL 09D

Shannon's rate distortion theory applies to a source with a known probability distribution. In many instances an encoder must be designed when only vague *a priori* knowledge is available concerning the source distribution. This study defines the rate distortion function for a class of sources, proves a corresponding coding theorem, and presents several examples. Author

N68-32353# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
A CONTACTLESS CODE-PULSE TELEMETRY INSTRUMENT
V. I. Kurotchenko and N. I. Babanin 31 Oct. 1967 10 p Transl. into ENGLISH from the publ. "Vsesoyuznoe Soveshchaniye Po Ferritam i Po Beskontaktny M Magnity M Elementam Avtomatiki. 3D", Minsk, Izd. and BSSR, 1963 p 399–405
(FTD-HT-23-765-67; AD-671589)

A noncontact telemetering system was developed. The device, BKU-60, intended for telemetering the axial angular displacement in multirotating primary measuring instruments consists of a receiving assembly and a transmitting semiassembly. The former

includes a feeder, a pulse-shaper, a single-pulse-shaper, a linear cell, a pulse distributor, a coincidence circuit, a decoder, a reading device, a distorted code execution arrester, a tube-failure distortion arrester, and an execution permitting unit. The latter includes the primary measuring instrument, an induction coding converter, a pulse distributor, a linear cell, a feeder, and a pulse-shaper. A call pulse, shaped by the single pulse shaper, is sent into the communication line by pressing the telemeter call button, and the receiving pulse distributor is simultaneously activated to convey pulses to the parallel coincidence circuit. At the controlled site the call pulse actuates the transmitting pulse actuates the transmitting pulse distributor which picks up the code set by the induction coding converter. The linear cell sends the code over the communication line to the linear cell and the parallel coincidence circuit of the receiving end which actuates the corresponding decoder cores, and pulses from the decoder actuate the commuting triggers of the counter, producing the final figure on the table. Author (TAB)

N68-32356# Army Electronics Command, Fort Monmouth, N. J.
FREQUENCY SHIFT KEYING LASER COMMUNICATION
Donald A. Smith (Ph.D. Thesis—Minn. Univ., Mar. 1968) Apr. 1968 144 p refs
(ECOM-2967; AD-671596)

A unique optical modulation and detection technique has evolved from an investigation of methods of digital modulation, transmission, and detection in the optical region. In particular a frequency-shift keying laser communication system has been demonstrated and the advantages of such a system have been shown. A detailed theoretical analysis of electromagnetic-wave propagation in an electrooptic crystal of arbitrary orientation was developed. In turn the parameters for an optical modulator capable of frequency-shift keying at a digital rate were determined. Based on this analysis a laboratory communication system incorporating FSK modulation and detection capabilities was built and successfully operated. The transmitter consists of two helium-neon gas lasers operating at wavelengths of 6328 Angstroms and 11523 Angstroms. The two beams are combined and pass through the KDP electro-optic modulator which is driven by a digital voltage of 100 volts peak amplitude. The receiver consists of two photodiodes, each detecting one of the wavelengths. The detected signals are processed by decision circuitry to retrieve the transmitted information. To evaluate the performance of an optical FSK system, error rate measurements were made in a simulated atmospheric type of environment and compared to similar measurements made with an amplitude-modulation communication system. Author (TAB)

N68-32378# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
CONCERNING THE RELIABILITY OF INFORMATION FROM NETWORKS OF REMOTE SYSTEMS HAVING DISPERSED UNITS
B. O. Kasimov 25 Jan. 1968 20 p Transl. into ENGLISH from Vychislitelnyi Tsentr., Tr. (Erevan), no. 3, 1965 p 33-47
(FTD-MT-24-389-67; AD-671875)

An information network is described having n + 1 dispersed units, any one of which may be the dispatcher, and containing an arbitrary number of reserve channels. The solution is carried out in two stages: (1) the choice of a measure of reliability for which two variant methods are given; (2) the choice of the dispatcher point in order to maximize the reliability of transmission from the point of view of connecting points of the network with the dispatcher. A graphical example is used throughout as an illustration. TAB

N68-32399 Rice Univ., Houston, Tex.
OPTIMAL RECURRENT CODES AND THEIR BEHAVIOR IN BURST-ERROR CHANNELS
George Paul, Jr. (Ph.D. Thesis) 1967 175 p
Available from Univ. Microfilms: HC $8.00/MF $3.00 Order No. 67-13113

Algebraic properties of burst-error-correcting convolutional parity check codes, were studied, and theorems are presented for conditions for a code to be optimal. Optimal codes are defined to be codes with the shortest possible constraint length which have a specified error correction capability and transmission rate. These codes also require the shortest possible guard space for the desired error correction capability. These conditions were used to derive an efficient search procedure which was implemented on a general purpose digital computer. A simulation study was undertaken to evaluate the performance of codes found in the first part and the performance of various decoding schemes using two burst-error channel models. Dissert. Abstr.

N68-32400 Florida Univ., Gainesville.
A DIGITAL SIMULATION STUDY OF AN AIRBORNE RADAR GROUND CLUTTER MODEL
Marvin Jack Moss 1966 83 p
Available from Univ. Microfilms: HC $4.40/MF $3.00 Order No. 67-13155

An investigation was conducted on the statistical properties of an airborne radar signal returned from various types of ground clutter. The representation of the ground for simulation on a digital computer is accomplished by division into subareas. Each subarea can be described in terms of parameters such as range, antenna weighting factor, Doppler frequency, relative time of arrival of signal return, and complex reflection coefficient. This coefficient contains the magnitude and phase of the reflectivity of a particular subarea. The values chosen for magnitude and phase come from assumed statistical distributions which represents various types of terrain such as grass, sand, and forests. All of the subareas whose signal return falls within a given time increment following the transmission of a pulse of carrier are summed vectorially using the basic radar range equation. Comparison of this analysis with similar information obtained from actual flights of radar over different types of terrain indicates a favorable degree of correspondence for several types of clutter. Dissert. Abstr.

N68-32410# Institute for Perception RVO-TNO, Soesterberg (Netherlands).
LATERALIZATION THRESHOLD OF A SIGNAL IN NOISE
T. Houtgast and R. Plomp [1968] 19 p refs
(IZF-1968-13; TDCK-51268) CFSTI: HC $3.00/MF $0.65

The accuracy of the perceived lateral position of a signal against a continuous background of masking noise was experimentally determined. Both signal and masker consisted of octave bands of thermal noise, with the same center frequency of 500 Hz. The signal-to-noise ratio and signal duration served as parameters. The results can be understood on a statistical basis, the random fluctuations of nerve impulses playing an important role. The fluctuations due to 'internal' noise are found to have a standard deviation of about 80 μsec. As a result of the increase of the sound pressure level, the onset part of the signal contributes more to the lateral position perceived than the ongoing part does. The relation to the precedence effect is discussed. The statistical procedure underlying the accuracy of the lateral position perceived suggests an approach to the BMLD effect based on a masking pattern in the bi-neural-hearing mechanism. Author

N68-32443 National Lending Library for Science and Technology, Boston Spa (England).
RS 1082 C-A TRANSMITTER TETRODE FOR SINGLE SIDE BAND TRANSMITTERS USED IN COMMERCIAL TELECOMMUNICATION SYSTEMS [RS 1082 C-EINE SENDETETRODE FUER EINSEITENBANDSENDER DER KOMMERZIELLEN NACHRICHTENTECHNIK]

Johannes Holle 18 Mar. 1968 19 p refs Transl. into ENGLISH from Siemens-Z. (Erlangen), no. 9, Sep. 1963 p 684–689 In GERMAN and ENGLISH
(EE-TRANS-1756) Available from Natl. Lending Library, Boston Spa, Engl.

Characteristics and operating data are given for a transmitter tetrode (RS 1082 C) with anode and screen-grid modulation operating in Class C and in a ground-cathode circuit. Design and amplitude linearity of this tetrode are described. Calculations are presented based on the oscillator characteristics recorded during an experiment, and a two-tone method was used to obtain coefficients of different tones of the transmitter valves. Application of the tetrode in the output stages of single sideband telecommunication transmitters, television picture transmitters, and medium capacity broadcasting transmitters is mentioned. M.W.R.

N68-32467# Sylvania Electric Products, Inc., Mountain View, Calif.
TIME CORRELATIONS IN FORWARD SCATTERING BY RANDOM DISTRIBUTIONS Final Report, 1 Apr. 1966–31 Mar. 1968
James E. Burke, Sandra W. Hawley, and Thomas H. Kays Apr. 1968 73 p refs
(Contract AF 19(628)-5886)
(SESW-E139; AFCRL-68-0223; AD-671539)

Experimental data are given for time-correlations in the forward scattering of 5-mm microwaves by moving random distributions of identical spheres. The component scatterers of the distributions are styrofoam spheres with radii large compared to the wavelength and with relative indices of refraction close to unity; the motion of the spheres arises from turbulent air streams flowing through grids that form the top and bottom of a styrofoam container. The experimental results include the autocorrelation functions for the phase-quadrature components, and the self coherence function (constructed by the autocorrelation and cross-correlation functions). The results were obtained by digitally analyzing tape recordings of the instantaneous signals. Data obtained in real time by processing the instantaneous signals with an electronic analog computer are also given to provide preliminary checks on the digital analyses.
Author (TAB)

N68-32489# Air Force Cambridge Research Labs., Bedford, Mass. Data Science Lab.
IMPROVED ANALOG VOICE COMMUNICATIONS
John D. Griffiths Apr. 1968 19 p refs *Its* Instrumentation Papers, No. 141
(AFCRL-68-0227; AD-671486)

In any peak-power limited, analog voice communications system, such as trunk telephone, air to ground radio, and point to point radiotelephone, the usual primary design criteria is to maximize the voice intelligibility, that is, the probability of correct reception of the voice message. For a given system configuration, it is possible to do this by means of an optimum frequency distribution of transmitter power through use of a transmitter filter. The criteria for optimization is maximum received voice information, or intelligibility. The engineering design and solutions of the transmitter filter are presented here, together with expected improvement under a variety of conditions. On the average the use of this filter is equivalent in communications effectiveness to doubling the transmitter power. Author (TAB)

N68-32499 National Lending Library for Science and Technology, Boston Spa (England).
STELLAR IMAGE FLUCTUATION AS A DESIGN CONSIDERATION IN PHOTOELECTRIC TRACKING SYSTEMS [UCHET FLUKTUATSII ZVEZDNYKH IZOBRAZHENII PRI PROEKTIROVANII FOTOELEKTRICHESKIKH SLEDYASHCHIKH SISTEM]
P. V. Nikolaev, I. P. Rozhnova, and Yu. A. Sabinin May 1968 14 p refs Transl. into ENGLISH from Izv. Krymsk. Astrofiz. Observ. (Moscow), v. 35, 1966 p 295–301
(RTS-4527) Available from Natl. Lending Library, Boston Spa, Engl.: 20s

The spectral densities of random effects arising from stellar image scintillation and flicker, due to the instability of the terrestrial atmosphere, are used to calculate the absolute error to be considered in the design of photoelectric guiders for automatic telescope tracking and to develop the structural layout of a photoelectric compensating device. Sirius scintillation and flicker recordings by means of a compensation tracking system showed good agreement with observations performed elsewhere. G.G.

N68-32512# General Electric Co., Syracuse, N. Y. Heavy Military Electronics Dept.
LINE SOURCE APERTURE MONOPULSE EXCITATIONS Final Report, 1 Apr. 1967–31 Mar. 1968
Richard R. Kinsey Apr. 1968 90 p refs
(Contract AF 19(628)-5905)
(AFCRL-68-0254; AD-671967)

Independent and interdependent line source aperture monopulse excitations have been derived for arbitrary pattern sidelobe constraints. A computer program, developed to solve for the required excitation coefficients, is outlined and appended. Numerical examples of independent excitations, which provide the maximum sum pattern gain factor or maximum difference pattern angular sensitivity factor, are compared with other reported aperture distributions. A tandem series-feed network capable of providing independent array excitations is described and the listing of a computer program for the practical design of a feed network is appended. Phased array applications to Displaced Phase Center Antennas, as used in airborne MTI systems, were investigated and the monopulse excitation requirements have been determined.
Author (TAB)

N68-32598 National Lending Library for Science and Technology, Boston Spa (England).
INTERCONTINENTAL DATA TRANSMISSION BY COMPUTER
Gino Puccioni and Fabrizio Quojani 9 Nov. 1967 14 p Transl. into ENGLISH of 2-45 Rept. Presented at the 67th Ann. Assembly of the Assoc. Electrotec. Ital., 1966 *Its* Transl. 2417
Available from Natl. Lending Library, Boston Spa, Engl.

Interconnection of data processers with intercontinental data transmission using satellites and submarine coaxial cable has been tried with success. The tests via satellite have been of particular interest, because these have shown the possibility of realizing intercontinental circuits of high quality with a minimum of errors due to transmission. Some of the systems used have shown themselves capable of overcoming the greatest existing technical difficulty, that is, the delay in propagation which occurs in transmission via satellite. The gradual expansion of communications via satellite and via submarine coaxial cable permits the prospect of an intercontinental switching service for the direct interconnection of processers and of terminal equipment peripheral to the processers themselves. Author

N68-32630 National Lending Library for Science and Technology, Boston Spa (England).
STATISTICAL ANALYSER
J. Max and H. Chevalier 9 Nov. 1967 12 p refs Transl. into ENGLISH from L'Onde Electrique (France), v. 46, 1966 p 1044–1050 Presented at the Colloq. on the Contrib. of Electron. to Statist. Process. Methods for Phys. Meas., Grenoble, 28–29 Apr. 1966 *Its* Transl. 2407
Available from Natl. Lending Library, Boston Spa, Engl.

A correlator, or calculator of correlation functions, is described which can work in real time quickly and with sufficient accuracy. It is also pointed out that with a slight increase in complexity and cost the apparatus can be transformed into a statistical analyser. The performance and operational characteristics of the correlator and of its essential components are discussed. Methods of using the correlator as a statistical analyzer are outlined for different measurements and analyses. N.E.N.

N68-32633# Sylvania Electric Products, Inc., Waltham, Mass. Applied Research Lab.
ACTIVE REFLECTOR OPTIMIZATION Final Report, 19 Oct. 1966–30 Nov. 1967
Robert Fekete Griffiss AFB, N. Y. RADC May 1968 200 p refs
(Contract F30602-67-C-0060)
(RADC-TR-68-11; AD-671523)

This report describes the active reflector optimization study which was conducted to determine the feasibility of increasing the scattering cross-section of antenna elements in the 0.2 - 10 GHz frequency range by terminating the antenna with a stable, negative-resistance, reflection-type amplifier. Analytical and experimental investigations showed that stable antenna-tunnel diode amplifier active reflectors are realizable in the VHF, UHF and microwave frequencies. It has been pointed out that the low output power of tunnel diodes is the main limitation of this type of active reflectors. By replacing the tunnel diode amplifier with an avalanche diode amplifier the output power was increased from the microwatts to the milliwatts level, providing an improvement of 30 db over the tunnel diode circuit. Author (TAB)

N68-32711*# ADCOM, Inc., Cambridge, Mass.
STUDY, EVALUATION AND ANALYSIS OF UNIFIED S-BAND SYSTEM FOR APOLLO GROUND NETWORK Quarterly Progress Report, 1 Jul.–30 Sep. 1968
Chi-Hau Chen, Cesar A. Filippi, and Kenneth W. Kruse 30 Sep. 1968 49 p refs
(Contract NAS5-9702)
(NASA-CR-96269; QPR-5) CFSTI: HC $3.00/MF $0.65 CSCL 09F

The Apollo unified S band phase-locked frequency demodulators are analyzed, and the limitations of certain assumptions regarding demodulator operations and effects on noise are determined. The analysis is applicable to the carrier frequency demodulator and the voice subcarrier demodulator. The acquisition time for the Apollo unified S band lunar length ranging code is computed, including the effect of noise on the received clock. Curves of acquisition time versus signal to noise density are plotted for each of the three clock loop bandwidth positions. A condition of possible carrier loop interference during simultaneous LEM-CSM pulse modulation operation is hypothesized. The mean square error for varying amounts of this interference are then calculated. The rejection required in the receiver's first IF filter and second mixer are estimated on the basis of these interference calculations. K.W.

N68-32761# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ANTENNAS AND RADIO-WAVE PROPAGATION
Ye. M. Vereshchagin 8 Jun. 1967 224 p Transl. into ENGLISH of the publ. "Antenny i Rasprostraneniye Radiovoln" Moscow, Voyannoye Izd. Min. Oborony SSSR, 1964 p 1–238
(FTD-MT-68-51; AD-671869)

Contents: Basic properties of antennas and radio waves; Antenna-feeder arrangements; Propagation of radio waves and application of them for radio communications; General form and basic data of certain antennas; Intensity of field of surface radio waves depending on distance and working frequency for calculated antenna; Radio weather forecast. TAB

N68-32804 Pennsylvania Univ., Philadelphia.
COHERENCE PROPERTIES OF RADIATION EMITTED FROM OR PROPAGATING THROUGH A RANDOM MEDIUM
Tien-lin Ho (Ph.D. Thesis) 1967 201 p
Available from Univ. Microfilms: HC $9.25/MF $3.00 Order No. 67-12752

The statistics of electromagnetic radiation field are investigated for radiation emitted from an extended turbulent source and for radiation propagating through a random medium. The turbulent source is assumed to consist of very many excited oscillating electric dipoles with statistically independent transition probabilities and random orientations. The turbulence is characterized by a random number-density of the dipoles in the extended source. The random medium through which the radiation propagates is characterized by a random refractive index. In both cases, and ensemble average is used to describe the stochastic nature of the radiation field. For radiation emitted from an extended source, both optically thin and self-absorbing gases are studied. The mutual coherence functions on the surfaces of a spherical source and a hemispherical source are calculated. It is found that certain degree of coherence does exist for separations within the order of the radiation wavelength. For a non-turbulent source, it is shown that the radiation field obeys gaussian statistics. Dissert. Abstr.

N68-32823# Hughes Aircraft Co., Fullerton, Calif. Ground Systems Group.
INVESTIGATION OF USE OF SUPERIMPOSED SURFACE WAVE MODES, PART 3 Final Report, 1 Mar. 1967–29 Feb. 1968
N. S. Wong, R. Tang, and S. W. Lee Mar. 1968 110 p refs
(Contract AF 19(628)-4984)
(FR-68-14-372, Pt. 3; AFCRL-68-0211; AD-671536)

A method of achieving a matched radiating element in both a phased linear array and a phased two-dimensional array over wide ranges of scan angle has been investigated. This method uses two or more propagating modes in each array element such that the reflections of these modes from the array aperture produce a cancellation effect at the elemental driving terminal. An experimental 32 element linear array was constructed to verify this technique. Each radiating element consists of an open-ended waveguide driven by an end-on coaxial transition in conjunction with offset posts for the appropriate excitation of the two lowest order modes. The measured input VSWR for this experimental array after optimal adjustment of the transducer was 1.17 or less over a scan range of plus or minus 54 degrees. This result agreed very well with the predicted value. Author (TAB)

N68-32913# Naval Research Labs., Washington, D. C.
ON THE TRANSIENT RESPONSE AND BACKSCATTER PROPERTIES OF LINEAR ANTENNAS Final Report
Sheldon Sandler May 1968 29 p refs
(NRL-6717; AD-671789)

Three papers entitled Transient Response of a Linear Antenna to Pulse Voltage Excitation, Transient Terminal and Field Properties of Linear Antennas and Backscattered Field of a Linear Antenna and a Two Element Array constitute the three chapters of this report. They represent the approach taken by Dr. Sandler to the analysis of scattering from an array of linear antennas. The first paper develops an expression for the far field of a linear antenna excited by a pulse. A simple approximation for the current distribution on the antenna is assumed in this derivation. The second paper deals with essentially the same problem only from a point of view which is analogous to traveling waves on a transmission line. The concepts developed in these two papers have been incorporated into the third to investigate the backscatter properties of both a linear antenna and an array composed of two linear elements. Author (TAB)

N68-32984# Michigan Univ., Ann Arbor. Radiation Lab.
PROPERTIES OF THE TRIANGULAR LATTICE ARRAY
David H. S. Cheng Jun. 1968 54 p refs
(Grant DA-ARO(D)-31-124-G-724)
(Rept.-7678-6-T; AROD-5638-4-E; AD-671691)

A new type of array consisting of elements arranged in a triangular lattice is studied in this report. The quary has radiation characteristics similar to those of a tapered array but does not require tapered excitation. A phased array of an arbitrary triangular lattice configuration is formulated using the vector model. It is applied to a special case of an isosceles triangular array. The directivity of the array is derived and expressed in a compact form, whereby its enumeration becomes a routine procedure for any total number of elements. A general method of evaluating the mutual coupling terms involving two inclined short dipoles is developed. Numerical results are presented and discussed as regards the radiation patterns and directivities of an isosceles triangular lattice array with its varying parameters such as the spacings between the adjacent elements and rows of elements, the phasings of the elements, and the size of the array. Author (TAB)

N68-33042*# Stanford Research Inst., Menlo Park, Calif.
THE EFFECTS OF A PLASMA IN THE NEAR-ZONE FIELD OF AN ANTENNA, 2
W. C. Taylor Washington NASA Sep. 1968 38 p refs
(Contract NAS1-7024)
(NASA-CR-1149) CFSTI: HC $3.00/MF $0.65 CSCL 09F

Measurements are reported on the effects on an antenna of a plasma in the near field. In one phase of the program, admittance measurements were performed with a Teflon-plugged waveguide slot antenna radiating into the flowing ionized gas of an arc-driven shock tube. The electron density was varied above and below the critical density at two different values of shock-tube pressure. The results are compared with theoretical predictions. Measurements were also made in the same shock tube to determine the ionization rise times in normal-shock-heated air and other planetary gas mixtures. The principal results of these measurements were to supply the ionization rise history in air and in a 90-percent N_2/10-percent CO_2 mixture over a wide range of pressures and shock speed. Author

N68-33061# Illinois Univ., Urbana. Aeronomy Lab.
ANTENNA DESIGN FOR A THOMSON SCATTER RADAR
J. V. Evans and Y. T. Lo 15 Oct. 1967 224 p refs *Its* Aeronomy Rept. No. 23
(Grant NSF GA-1046)

The proposed facility is required for studies of the upper atmosphere in the altitude range from 90 to 2000 km by observing the Thomson scattering of radar signals by the free electrons in the ionosphere. Electron and ion temperatures and densities are also to be determined within that range. The present report considers in detail the type and distribution of antennas to be used in the facility. Antenna disposition and arrangement to measure the three mutually perpendicular velocity components of the ion drift are summarized. Size of the antennas for adequate signal to noise ratio and height resolution are examined in order to assess the accuracy with which Doppler shifts in the spectra and wind velocity may be determined. Dipole arrays and reflecting elements are studied for sensitivity and angular resolution at minimum cost. Specifications for a candidate fully steerable parabolic reflector design, 100 m in diameter and with Cassegrain optical configuration, are developed. The high power feed system for this antenna is discussed. The design of two additional identical tiltable paraboloidal reflectors 66 m in diameter is also outlined. K.W.

N68-33162*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
UNIFIED S-BAND RECEIVER-EXCITER SUBSYSTEM
Robert C. Bunce 15 Sep. 1968 19 p
(Contract NAS7-100)
(NASA-CR-96384; JPL-TR-32-809) CFSTI HC $3.00/MF $0.65 CSCL 17B

This report summarizes the functional capabilities and physical arrangement of the receiver-exciter subsystem, a part of the unified S-band Apollo communications and tracking ground-station system. The functional operation is initially described, in relation to the other interfacing equipment, by separate explanations of four relatively independent capabilities: doppler extraction, two-way communications, angle-tracking, and ranging. Somewhat more detailed information is then covered for the main receiver phase-lock and AGC loops and the ranging receiver phase-lock loops, since an understanding of these loops is fundamental to a comprehension of the equipment design concepts. Finally, the report gives a brief physical description of the equipment layout and control panel functions. Author

N68-33179*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
BROADCAST RADIO AND TELEVISION SATELLITE REQUIREMENTS
Fred E. Digesu *In its* Aerospace Electron. Systems Technol. 1967 p 153–168 refs (See N68-33169 20-30)

Interrelationships between the parameters influencing communication satellite missions are assessed as a basis for discussing the technological developments necessary for future missions. Spacecraft subsystems requirements and studies to resolve these problems are discussed. These include: (1) An antenna experiment for the Apollo Applications Program (AAP) was defined, and space erectable antenna concepts were analyzed and compared. Development time for the expandable truss paraboloid and the inflatable structure concepts is estimated at from 3 to 4 years. (2) Broadcast mission requirements for improved antenna gain and effective radiated power (ERP) implies a more sophisticated attitude control system with perhaps three-axis stabilization. (3) As the missions planned for the 1970s cover a range of ERPs from 30 to 80 dbW, a study on transmitters is being conducted to obtain empirical data on weights, volumes, and cost. Voice broadcast mission studies resulted in spacecraft configuration concepts for hf, vhf, and uhf transmission. Also presented are on configurations for a noncommercial educational television network, community television, and a satellite system for use with augmented home receivers. M.G.J.

N68-33180*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
MICROWAVE DEEP SPACE COMMUNICATIONS AND TRACKING IMPROVEMENT POTENTIAL
Eberhardt Rechtin *In* NASA, Washington Aerospace Electron. Systems Technol. 1967 p171–177 (See N68-33169 20-30)

Microwave communications potential for spacecraft, earth stations, and resultant data rate are tabulated for the Mariner Mars 1964, Mariner Mars 1969, and Mariner Mars 198-. Data are also presented on the achievable positional accuracy at Mars with earth-based microwave tracking, and station costs to produce a 64-meter and 128-meter equivalent antenna capability; microwave and laser links for deep-space communications to earth are compared. It is predicted: (1) A 3-fold to 10-fold increase can be expected in the spacecraft antenna diameter and a 5-fold to 25-fold increase in the spacecraft transmitter power. (2) The sensitivity of microwave ground stations can be improved by perhaps a factor of 2 as a result of improved ground antenna microwave design. The most economical approach for deep space communication is to use an array of 64-meter antennas of the present design. (3) It does not appear likely that within the next decade antennas larger than 64 meters, flat arrays, or laser links will be built, nor will data compression be used for the whole data stream. (4) The principal and most effective relay links will be from landed devices on the other planets to a planetary satellite relay to earth. M.G.J.

N68-33181*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.

OPTICAL COMMUNICATIONS FROM DEEP SPACE

J. L. Randall *In its* Aerospace Electron. Systems Technol. 1967 p 179–187 (See N68-33169 20-30)

The problems associated with optical communication are identified as (1) pointing of the very narrow fractions of an arc second) optical beams to insure interception by the receiver in the presence of point-ahead requirements caused by velocity aberration; (2) acquisition and tracking of the intercepted beam by the receiver; (3) atmospheric disturbances; (4) electrical efficiencies of the lasers and modulators; and (5) maintenance of diffraction-limited optics or antennas. Pointing system configurations under study are the open-loop, cooperative, and closed-loop systems; probably a cooperative system or the closed-loop system with possibly a combination system will be used. The basic concept of the two-way optical communication link is discussed and depicted. Examples are given to show the data rates attainable with optical systems; in the visible region incoherent detection is superior to coherent detection, while coherent detection is superior at 10.6 μ. Optical and radio frequency systems are compared with respect to those factors affecting the efficiency of utilization of primary energy. Required technology advances are indicated. M.G.J.

N68-33220*# Michigan Univ., Ann Arbor. High Altitude Engineering Lab.

ANTENNA ADMITTANCE IN AN IONOSPHERIC-TYPE PLASMA Scientific Report

E. K. Miller and H. F. Schulte, Jr. Apr. 1968 65 p refs Presented at the NATO Advanced Study Inst. on Plasma Waves in Space and the Lab., Roros, Norway

(Contract NASr-54(05); Proj. ORA 05627)

(NASA-CR-96381; Rept.-05627-18-S) CFSTI: HC $3.00/MF $0.65 CSCL 09F

An analysis of a plasma-immersed antenna, undertaken in support of an experimental program of ionospheric measurements with emphasis on the electron density, is discussed. Some numerical results for the admittance of an infinite cylindrical antenna in an ionospheric-type compressible magnetoplasma show that for frequencies on the order of 1.5 to 2 times the electron cyclotron frequency (f_h), the infinite antenna admittance is relatively unaffected by the plasma compressibility and ion sheath. Consequently, the use of a finite antenna theory which neglects the plasma compressibility and sheath appears to provide a reasonable first-order approximation for the impedance of an antenna in the ionosphere. A comparison of some experimental impedance results obtained from a rocket-borne antenna experiment with values calculated from Balmain's theory provides evidence of this, with good agreement being obtained between the theoretical and experimental impedance values for frequencies on the order of 2 f_h and higher. The infinite antenna impedance is found to be qualitatively in agreement with the experimental results, in particular in shifting an impedance minimum upward in frequency from f_h due to a sheath. Author

N68-33222# Joint Publications Research Service, Washington, D. C.

POLARIZATION CHARACTERISTICS OF PARABOLIC DISH ANTENNAS

R. Iyen 21 Aug. 1968 12 p refs Transl. into ENGLISH from Radiotekhn. i Elektron. (Moscow), no. 2, 1968 p 212–218

(JPRS-46240) CFSTI: HC $3.00/MF $0.65

Using elliptical polarization of the radiated field is characteristic of modern radar on centimeter waves. Therefore, the antennas must be developed from the point of view of insuring not only the required directional properties but also the necessary polarization characteristics. Approximate formulas were obtained by the Kirchhoff method for complex radiation patterns of horn and parabolic dish antennas describing both the directional and polarization properties of these antennas. The formulas are suitable for engineering calculations and permit us to judge the variation in polarization within the limits of the radiation pattern and the relation between the polarization characteristics of the pattern of the radiator (the primary pattern) and the pattern of the parabolic dish antenna as a whole (the secondary pattern). Some results of these calculations also constitute part of the present papers. Author

N68-33234# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

ONE METHOD FOR THE SYNTHESIS OF DECODERS WITH A SEPARATED LOAD [OB ODNOM SPOSOBE SINTEZA DESHIFRATOROV S RAZDELENNOY NAGRUZKOY]

F. N. Zykov 13 Oct. 1967 10 p refs Transl. into ENGLISH from the Publ. "An Ukrsr. Kiberneticheskaya Tekhnika" Kiev, Naukova Dumka, 1965 p 51–58

(FTD-HT-23-691-67; AD-667748)

Standard decoding circuits with a separated load require a considerable code excess at the input, which leads to substantial expenditures for the devices. The present author examines the feasibility of constructing decoders on the basis of reduced codes which use 'determining' classes of the orthogonal code. The employment of this code in conjunction with the simultaneous use of summation of current and voltages makes it possible to save on the equipment and to simplify the manufacture of decoders. Designs of several decoders are studied as an example. An investigation is made of the effectiveness of a decoder which combines the functions of decoding and multiplication of matrices with the simultaneous use of the method of summation of current and voltage, as compared, for example, with a decoder designed according to the principle of voltage summation. It is found that the proposed combined method produces a design of a decoder more effective than known designs, since it requires less components. The effectiveness of the circuit rises with an increase in the number of decoder outputs. Author (NSA)

N68-33343 National Lending Library for Science and Technology, Boston Spa (England).

SOME EXPERIMENTAL CORRELATION FUNCTIONS

J. Cazemajou and G. Marc 9 Nov. 1967 24 p refs Transl. into ENGLISH from Onde Electrique (France), v. 46, no. 475, Oct. 1966 p 1074–1084 Presented at the Colloq. on the Contrib. of Electron. to the Methods of Statist. Process. of Phys. Meas., Grenoble

Available from Natl. Lending Library, Boston Spa, Engl.

Theoretical principles and principles of operation of a proposed correlator for analyzing correlation functions of noise (autocorrelation), and of linear systems (intercorrelation); are described. The proposed apparatus is composed of two units having the dimensions 50×30×65cm. The first unit contains the circuits of calculation, input, and output and the second the power supply and memory blocks. The correlator is entirely transistorized. To demonstrate the capabilities of the proposed correlator, measurements were made of autocorrelation and intercorrelation functions (1) without parasitic noise (nuclear reactors) and (2) of signals disturbed by a noise whose amplitude is variable with respect to that of the signal (RC circuits). Advantages and disadvantages of the proposed correlator which were established on the basis of data derived from the above experiments are discussed. It is concluded that the dynamics of the proposed apparatus are better adapted to the detection of periodic signals swamped in noise than to the extraction of exponential pulse responses. S.C.W.

N68-33344 National Lending Library for Science and Technology, Boston Spa (England).

DEVICE FOR THE AUTOMATIC CALCULATION OF CORRELATION FUNCTIONS FOR ACOUSTIC SIGNALS

D. Berthier 9 Nov. 1967 13 p Transl. into ENGLISH from L'onde Electrique (France), no. 46, 1966 p 1067–1073 Presented at the Colloq. on the Statist. Process. of Phys. Meas., Grenoble, 26–29 Apr. 1966 *Its* Transl. 2410
Available from Natl. Lending Library, Boston Spa, Engl.

Design concepts and principles of operation of a proposed real time multipoint correlator for the automatic calculation of correlation functions for acoustic signals are described. Technical considerations relating to the following three operations are discussed: (1) delay (on one channel X or Y); (2) multiplication (as many multiplications as points n, where n 50); and (3) integration (as many integrations as points n). A compromise between numerical processing and analog processing of correlation functions was selected as the best design approach. The correlation function of white noise filtered in a band-filter at 20 dB per decade is determined to demonstrate the applicability of the proposed device. S.C.W.

N68-33353 National Lending Library for Science and Technology, Boston Spa (England).
THE TRANSMISSION OF PCM PULSES OVER COAXIAL CABLES COMPARED WITH CARRIER FREQUENCY TECHNIQUE
Ernst Kettel 24 Jul. 1968 10 p refs Transl. into ENGLISH from NTZ-Nachrtech. Z. (Brunswick), v. 21, no. 1, Jan. 1968 p 24–27 *Its* Transl. No. 2485
Available from Natl. Lending Library, Boston Spa, Engl.

Repeater spacing length requirements for long distance telephone transmission via coaxial cables using single sideband carrier frequency techniques, and PCM techniques are assessed in an attempt to establish the future potential of PCM in this capacity. In contrast to previous views that the repeater spacing for PCM systems must be closer than those of carrier frequency systems, it is argued that the signal to noise ratio at the repeater inputs can be very much lower with PCM, and that only the error probability in the pulse regeneration is additive as the length of the system is increased, and not, as in the case of the carrier frequency system, the noise contributions of the individual repeaters. It is shown that (1) as the number of speech channels to be transmitted increases, repeater spacing for the PCM system becomes greater than that for the carrier frequency system; and (2) the lower the power handling capacity of the repeaters, the more competitive PCM system is with the carrier frequency technique, particularly in the case of amplifiers with small output power handling capacities and with careful pulse shaping. S.C.W.

N68-33401# Watkins-Johnson Co., Palo Alto, Calif.
NEXT GENERATION DIGITALLY CONTROLLED MICROWAVE SURVEILLANCE RECEIVER SYSTEMS
R. H. Rector and A. D. Marez *In* AGARD Advanced Tech. for Aerospace Surveillance 1968 p 149–166 (See N68-33392 20-14)

This paper describes a next generation microwave digitally tuned scanning superheterodyne receiver which outperforms conventional analog tuned microwave receivers and which is fully developed to update all military surveillance systems. These new concept reconnaissance receivers are developed around the stable dual conversion technique and a unique Yttrium Iron Garnet (YIG) filter used as a wideband, high selectivity preselector and local oscillator tracking filter. These receivers are characterized by their frequency accuracy, resettability, stability, linearity of tuning, high speed electrical tunability, and adaptability to remote control. Applications include: sensitive laboratory receivers, ground and airborne search and tracking systems, automatic intercept applications, and spectrum surveillance. Author

N68-33510# Joint Publications Research Service, Washington, D.C.
THE INFLUENCE OF THE SPHERICITY OF THE EARTH ON VLF RADIOWAVE PROPAGATION
P. Ye. Krasnushkin 23 Aug. 1968 11 p refs Transl. into ENGLISH from Radiotekhn. i Elektron. (Moscow), no. 2, 1968 p 340–344
(JPRS-46273) CFSTI: HC $3.00/MF $0.65

Sphericity effects caused by diffraction on the convexity of the earth and on concave layers of the atmosphere are found to develop gradually with an increase in distance from the emitter of very low frequency radio waves. At distances greater than 300 to 500 km from the emitter, the entire picture of terrestrial VLF propagation is changed because of the earth's sphericity. A study was made by comparing the numerical solutions for the boundary problem of terrestrial VLF theory with the actual radius of the earth and an infinite radius in which all of the parameters of the VLF waveguide and the emitter currents influencing the terrestrial VLF propagation were kept invariant and close to actual values. An expression is given for the shape of the terrestrial atmospherics excited by a Hertz dipole with a given radiation constant, and some numerical results are included. M.W.R.

08 COMPUTERS

Includes computer operation and programming; and data processing. For basic research see: 19 Mathematics.

N68-32245# RAND Corp., Santa Monica, Calif.
THE DYNAMIC CHARACTERISTICS OF COMPUTER PROGRAMS
G. E. Bryan Aug. 1967 27 p Presented at the 22d Ann. Meeting of SHARE, San Francisco, 2–6 Mar. 1964
(P-3661)

The multiplexed computer program mode of operation is proposed as one way to achieve more efficient utilization of computing facilities. Multiplex programs situations involve storage allocation, job selection algorithms, and time of changing programs in and out of main memory. To address these questions and to design effective algorithms, some program characteristics need to be determined such as program size distribution, running time distribution, correlation between running time and size, storage use, and identification and time distribution of idle intervals. Data were obtained on jobs and programs for one facility. An analysis of the data demonstrates that multiplexed program mode operation would improve utilization of facilities in running time and in storage allocation with a prediction of 100% through-put gain. D.H.B.

N68-32247# Maryland Univ., College Park. Computer Science Center.
THE APPLICATION OF VISUAL DISPLAY MAN-MACHINE INTERACTION TO OPTICAL MODEL FITTING OF ELASTIC SCATTERING DATA
Howard Daniel Wactlar May 1968 147 p refs
(Grant NGL-21-002-008)
(TR-68-65) CFSTI: HC $3.00/MF $0.65

To permit a trained scientist to interject his subjective opinion during complex data analysis phases, a generalized experimental analysis technique was developed for phenomenological problems whose solution is based upon a modelistic approach. Written in FORTRAN 4, the GSEEK program was designed to perform a graphical, man–machine interactive, manual or automatic search procedure. It is organized in modular form so that it may be made to run on varied systems merely by replacing the input–output control routines and the graphical display subprograms. The program was written to perform optical model analyses of elastic scattering data for particles of spin 0 or 1/2 scattered against targets of complex nuclei with 0 spin, and to manually or automatically search

for optimum fits to cross sections and polarizations in which the reaction cross section and any of the optical model parameters may be constrained. The mathematical model is formulated, and the program listing is included. M.G.J.

N68-32281 Case Inst. of Tech., Cleveland, Ohio.
LEARNING THROUGH PATTERN RECOGNITION APPLIED TO A CLASS OF GAMES
Elliot Bruce Koffman (Ph.D. Thesis) 1967 155 p
Available from Univ. Microfilms: HC $7.20/MF $3.00 Order No. 67-16082

The objective of this research was to investigate a technique for machine learning useful in solving problems involving forcing states. In games or control problems, a forcing state is a state from which the final goal can always be reached, regardless of what disturbances may arise. A program which learns forcing states in a class of games (in a game-independent format) by working backwards from a previous loss has been written. The class of positions which ultimately results in the opponent's win is learned by the program (using a specially designed description language) and stored in its memory together with the correct move to be made when this pattern reoccurs. During future plays of the game, these patterns are searched for. If they are formed by the opponent, the learning program blocks them before the opponent's win sequence can begin. If they are formed by the learning program, it initiates the win sequence. Dissert. Abstr.

N68-32277 Polytechnic Inst. of Brooklyn, N. Y.
ON THE ASSIGNMENT PROBLEM OF SYNCHRONOUS SEQUENTIAL MACHINES
Peter Weiner (Ph.D. Thesis) 1967 100 p
Available from Univ. Microfilms: HC $5.00/MF $3.00 Order No. 67-13429

The assignment problem of synchronous sequential machines is one that can in principle be solved by enumeration, but in actuality is unsolved. The hopelessness of the enumerative approach was demonstrated in the past by counting the number of distinct state assignments. These formulae, however, require modification under certain conditions. The primary objective is the development of a programmable algorithm for the assignment of state, input, and output symbols of an arbitrary sequential machine to simultaneously minimize the state and output logic. The algorithm presented minimizes any complexity measure that evaluates reduced dependencies in the logic equations of the realization. The method is non-enumerative in the sense that the first assignment found is optimal. Dissert. Abstr.

N68-32348# Technical Univ. of Denmark, Lyngby. Lab. of Electromagnetic Theory.
A FORTRAN 4 SUBPROGRAM FOR PLOTTING CURVES ON A CALCOMP 563 DIGITAL PLOTTER
Erik Drago Nielsen 15 Mar. 1968 32 p
(Contract F61052-67-C-0056)
(5183-R65; AFCRL-68-0315; SR-1; AD-671554)

A FORTRAN IV subroutine for plotting arbitrary curves in connection with computation of data has been developed. It is provided that the plotting is carried out on a CALCOMP 563 Digital Plotter since some special auxiliary programs developed for the CALCOMP Plotter have been used. The program performs the plotting of curves in rectangular as well as polar coordinate systems. It has been developed for plotting current distributions and radiation patterns in connection with an investigation of backfire antennas, but may of course be used for the plotting of other functions also. Author (TAB)

N68-32376# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
MAGNETIC IMMEDIATE-ACCESS STORAGE UNIT (MOZU) ON FERRITE PAIRS
G. K. Afanasev 27 Nov. 1967 13 p Transl. into ENGLISH from Vychislitelnaya Tekhn. (Minsk), 1965 p 140–148
(FTD-MT-24-327-67; AD-671957)

A method of increasing the reliability of magnetic core memories through utilization of so-called core pairs is the subject of this paper. The method is based on full currents, rather than on the coincidences of two half-currents, which renders the memory quite insensitive to power supply fluctuations. Because of its slowness and relative complexity, the core pair memory is best suited for special purpose computers not requiring large storage capacity. A reduction in power is possible if cores having low coercive force are used. The author includes a mathematical analysis of the optimum pulse shape for the reset pulse and the configuration of the address system. TAB

N68-32380# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
AN ANALOG COMPUTER ADAPTOR UNIT FOR DETERMINING THE AUTOCORRELATION AND CROSSCORRELATION FUNCTIONS
Z. Sh. Kipshidze and A. M. Morozov 16 Nov. 1967 21 p refs Transl. into ENGLISH from Vychislitelnyi Tsentr., Tr. (Tbilisi), v. 6, no. 1, 1965 p 42–58
(FT-MT-24-326-67; AD-671956)

An adaptor unit is described for a special purpose analog computer for calculating the auto- and the cross correlation functions of random input signals. It contains a calibrating cathode follower, three tube-capacitor memory cells, a monostable multivibrator, and a pulse shaper circuit. The correlator multiplier and integrator blocks are not part of the adaptor unit. The cathode follower is used for checking the linearity of the memory cells. The monostable multivibrator delay time may be varied from 5 to 550msec in 5msec steps. The correlator unit may accept input signals which are bandlimited to 800cps. Its minimum and maximum correlation times are 5msec and 0.55sec, respectively. It operates in the discrete mode utilizing the signal-sampling technique. The error analysis for both the auto- and the crosscorrelation mode of operation is given. The errors depend on the number of samples, duration between samples, and the total integration time. Author (TAB)

N68-32422# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
PHYSICAL BASES OF CERTAIN TEST PROGRAMS FOR IMMEDIATE-ACCESS MAGNETIC MEMORY UNITS
A. V. Gusev 8 Nov. 1967 21 p refs Transl. into ENGLISH from Tsifrovaya Vychislitelnaya Tekh. i Programmirovanie, no. 1, 1966 p 74–86
(FTD-MT-24-321-67; AD-671955)

The article examines various matters involving numerical and qualitative evaluation of test programs from the standpoint of their effect on storage environment and the electronic equipment of immediate-access magnetic storage units. At the present time tests for immediate-access magnetic storage units of some digital computers are compiled without taking into consideration the parameters of the ferrite cores and the electronic circuits. When tests for these units are compiled the number of shifts of magnetic state from zero or unity to the state determined by the static hysteresis loop, the number of partial access currents to which the cores are subjected and the equiprobability of keeping zero or unity in each digit position must be based on calculations. Correctly compiled tests are ranked by complexity of execution as follows: checks on the electronic part, tests of storage of random information, checks on the magnetic part of the immediate-access magnetic storage unit. Author (TAB)

N68-32435 National Lending Library for Science and Technology, Boston Spa (England).
DETERMINATION OF THE OVERALL COEFFICIENT OF EXCESS AIR DURING THE TRANSITION PROCESSES OF A DIESEL [OPREDELENIE SUMMARNOGO KOEFFITSIENTA IZBYTKA VOZDUKA PRI PEREKHODNYKH PROTSESSAKH DISELYA]
O. B. Leonov and I. V. Leonov Apr. 1968 9 p ref Transl. into ENGLISH from Izv. Vyssh. Ucheb. Zaved., Mashinostro. (Moscow), no. 12, 1966 p 87–91
(RTS-4438) Available from Natl. Lending Library, Boston Spa, Engl.: 12s 6d

A method for calculating the overall coefficient of excess air during the transition processes of a diesel engine is proposed using data from static tests. Experimental and calculated relations between load and control characteristics are compared, and the effect of rate of engine loading on the minimum value of the coefficient of excess air during the transition process is analyzed.
Author

N68-32454 National Lending Library for Science and Technology, Boston Spa (England).
MAC-1 ELECTRONIC ANALOG COMPUTER [CALCULATORUL ELECTRONIC ANALOGIC MAC-1]
Adrian Petrescu, Ivan Sipos, Marius Guran, and Petre Dimo 14 Jan. 1968 13 p refs Transl. into ENGLISH from Automatica si Electronica (Rumania), v. 10, no. 4, 1966 p 160–164 In ENGLISH and RUMANIAN
(EE-TRANS-1717) Available from Natl. Lending Library, Boston Spa, Engl.

The analog computer designated MAC-1 is described, along with its operational amplifier and some static and dynamic measurements of amplification. Nonlinear elements of the computer, control system operation, and computer power supply unit are considered.
M.W.R.

N68-32478 British Hydromechanics Research Association, Cranfield (England).
A COMPUTER SYSTEM FOR THE PROCESSING OF PUMP PERFORMANCE DATA
J. K. Hughes (W. H. Allen Sons and Co., Ltd., England) and P. W. Lightfoot (W. H. Allen Sons and Co., Ltd., England) 1967 8 p Presented at the 9th Members Conf., Cranfield, Sep. 1967
(SP-910)

This paper shows how the use of a digital computer has improved the cost and time effectiveness of various experimental pump development programs. The Elliott 803 computer program used is very comprehensive with facility for calculating head, quantity flow, power, efficiency, N.P.S.H. and flow traverse data for one or two stage machines. The program can be used for air and water testing with optional output in graphical form. It is believed that the whole system could be very useful for routine production testing enabling, if required, automatic storage of test data. This facility would be a very useful aid in tendering and estimating processes. The computer program has been developed using locally available computer service bureau facilities and is therefore of interest to small companies not possessing their own computer.
Author

N68-32513# Standard Research Inst., Menlo Park, Calif.
RESEARCH ON INTELLIGENT QUESTION-ANSWERING SYSTEMS Final Report, 15 Apr. 1966–14 May 1968
Bertram Raphael May 1968 13 p ref
(Contract AF 19(628)-5919)
(AFCRL-68-0266; AD-671970)

The report summarizes two years of research effort that included studies of computer memory organization, formal theorem-proving techniques, the application of theorem-proving techniques to n w problem domains, and the use of limited natural language input to a question-answering system. The principal accomplishments of the project were (a) the discovery of some interesting ways of relating formal theorem-proving to practical question-answering and problem-solving tasks, and (b) the implementation of a system of computer programs that demonstrate the approach and facilitate further research. The report describes briefly the areas of research covered, and then presents abstracts of four papers that contain extensive description and technical detail of the work.
Author (TAB)

N68-32523# RAND Corp., Santa Monica, Calif.
GRAIL/GPSS: GRAPHIC ON-LINE MODELING
J. P. Haverty Jun. 1968 15 p Presented at the IBM Seminar on Operations in Aerospace Ind., Models in Planning and Control, Newport Beach, Calif., 29–30 Apr. 1968
(P-3838; AD-671917)

Computer-based simulation has always been one of the major techniques used in system analysis but many analysts have objected to the lead-time required to develop a useful model. This is a status report on a capability being developed at The RAND Corporation that attempts to provide the systems analyst with a whole new dimension in the field of simulation and, in particular, offers an opportunity for major decreases in the amount of analysts time required to produce a working simulation model. The Paper reviews some of the deficiencies in the current art of model-building, describes a research project that formed an essential base on which to build this new dimension of capability, and illustrates the progress of the project to date.
Author (TAB)

N68-32539# Michigan Univ., Ann Arbor.
THE MTS DATA COLLECTION FACILITY
Tad B. Pinkerton Jun. 1968 45 p
(Contract DA-49-083-OSA-3050; ARPA Order 716)
(MEMO-18; AD-671757)

A software system for obtaining computing system and program performance data is described. It includes programs for the collection of such data from the Michigan Terminal System (MTS) and its analysis to produce a general description of program behavior. Procedures for gathering data and using the analysis programs are given, along with examples of the output.
Author (TAB)

N68-32599# Oregon State Univ., Corvallis. Computer Center.
DESIGN AND EVALUATION OF A GLASS DELAY LINE CONTENT-ADDRESSABLE MEMORY SYSTEM
Peter Turner Rux (Ph.D. Thesis) 9 Feb. 1968 102 p refs
(Contract Nonr-1286(11))
(C-68-5; AD-671910)

The high cost of content-addressed memories (CAM) can be reduced significantly by using a circulating memory system. With the circulating system comparison logic is shared by many memory locations to allow a reduction in cost. Three data organizations are described and evaluated and one is chosen as the best for implementation when 20 MHz, 100 microsecond glass delay lines are used. The complete design of a CAM system is described which has a 2048 x 35-bit capacity and is capable of searching the entire contents in 100 microseconds. Search criteria include equality and magnitude conditions. Operations include storing, fetching, and a variety of tagging functions. The described CAM has been constructed and installed as an operating addition to a general-purpose serial computer, the NEBULA. The CAM system has been a powerful addition to the NEBULA and a similar system could be a useful yet economical addition to any computer system.
Author (TAB)

N68-32620# Carnegie-Mellon Univ., Pittsburgh, Pa. Dept. of Computer Science.
USING A COMPUTER TO DESIGN COMPUTER INSTRUCTION SETS
Frederick Marion Haney (Ph.D. Thesis) 20 May 1968 248 p refs
(Contract ARPA SD-146)
(AFOSR-68-1612; AD-671939)

The purpose of the research described in this thesis is to develop a method for using a computer to design computer instruction sets and to experiment with instruction set design strategies. One result is GIS (Generalized Instruction Set) -- a model of the concept instruction set. The primary result -- ISDS (Instruction Set Design System) -- is a hierarchy of IPL-V subroutines that perform the bookkeeping, specification, and analysis required to construct a GIS representation of an instruction set in the memory of a computer. Also described is a heuristic program, written in ISDS, that determines its own strategy for designing an optimal instruction set for a given programming environment. Evaluation is provided by an instruction mix and a scoring polynomial whose coefficients specify the relative cost and value of addressing features. The program can design instruction sets with almost any addressing feature used in existing computers, but the instruction sets are restricted primarily to a single instruction format. Twelve examples are presented to show how various instruction sets can be obtained by altering the input, altering evaluation parameters, and extending the system. The examples include design strategies for the instruction formats of the IAS computer, Whirlwind I, and the Univac 1108. Author (TAB)

N68-32776# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
CYCLIC CODE DECODING WITH DOUBLE CODE CORRECTION [KODY S ISPRAVLENIYEM OSHIBOK PRI ARIFMETICHESKIKH OPERATSIYAKY]
V. D. Kolesnik and Ye. T. Mironchikov 17 Jul. 1967 19 p refs Transl. into ENGLISH from Akad. Nauk SSSR, Probl. Peredachi Inform. (Moscow), v. 1, no. 3, 1965 p 86-98
(FTD-HT-23-503-67; AD-671559)

The practical use of correcting codes hinges on the design of sufficiently simple setups capable of realizing the correction potentialities of such codes. The present article establishes decoding systems for cyclic codes correcting double independent errors. The entire decoding device is built from shifting registers with feedbacks. For a code length n, the size of the device grows as log n to the base 2. This feature distinguishes this particular algorithm from other decoding methods in which the instrument size increases at least proportionally to n and sometimes even faster. A general description of cyclic codes with the correction of double independent errors is followed by a detailed presentation of the appropriate decoding algorithm, and the description of the shifting registers with feedbacks. The paper concludes with a discussion of various decoding devices and an illustrative example of a fifteen-term sample transmission by code capable of correcting double and discovering triple independent errors. Author (TAB)

N68-32778 National Lending Library for Science and Technology, Boston Spa (England).
THE REPRESENTATION OF FIELDS OF METEOROLOGICAL ELEMENTS WITH THE HELP OF ALPHANUMERIC PRINTOUT EQUIPMENT
E. E. Tolstikov and I. A. Cetverikov [1968] 9 p refs Transl. into ENGLISH from Gidromet. Nauc-Issled. Cent. SSSR (Leningrad), no. 11, 1967 p 179-183 in ENGLISH and RUSSIAN
(M-7128) Available from Natl. Lending Library, Boston Spa, Engl.

A wide-carriage mechanical printer designed for printing out the computations made by an electronic computer, can be used for printing-out meteorological charts in operational analysis and forecasting routines. This kind of presentation is particularly useful in handling both terrestrial and satellite data. This paper describes an algorithmic method for obtaining such charts from a computer. The intervals between isolines are filled in by numbers of a given value and precise values are printed out at the grid points. If required isolines may be produced on such charts by drawing round the regions with the same values. The alpha-numeric print out machine gives 128 characters per line of width 512 mm. The Russian alphabet, Arabic numerals and certain auxiliary signs having dimensions of 4×6 mm are provided. In the algorithmic printout it must be remembered that the charts require a large number of values. Thus a chart measuring 512×512 mm will take 10880 numbers. Author

N68-32785# Michigan Univ., Ann Arbor.
A CYCLIC CHECK COMPUTER FOR ERROR DETECTION
Kenneth E. Burkhalter Jun. 1968 84 p
(DA-49-083; AD-49-083; ARPA Order 716; Proj. Concomp)
(TR-19; MEMO-19; AD-671758)

The report discuses the design and use of equipment built to aid intercomputer communicatitions via serial-synchronous data transmission techniques. The interface described computes on a character-by-character basis, a cyclic redundancy block checksum which is appended to outgoing or checked against incoming messages. This hardware techniques reduces checksum computation on a small computer from several hundred microseconds per character to only several microseconds; a reduction that is necessary if more than several 201 type data modems are to be operated simultaneously under control of a single processor. Basic design objectives and decisions are described first. A brief overall system description with background information is then followed by programming considerations and detailed descriptions of the checksum computer logic. Finally diagnostic software and wirewrap documentation is provided for maintenance and/or reproduction purposes. Author (TAB)

N68-32815# Pennsylvania Univ., Philadelphia. Moore School of Electrical Engineering.
ON-LINE TYPEWRITER ACCESS TO CLASSIFICATION TABLES ON DRUM STORAGE Scientific Interim Report
Marc Fogel Apr. 1967 37 p ref
(Contract AF 49(638)-1421)
(Rept.-67-23; AFOSR-68-1604; AD-671978)

A system is described for experimenting with classification tables for information storage and retrieval systems. A desideratum are tables that display, for indexing and search purposes, such relationships as synonymy, genericity-specificity, whole-part, process-product, and noun modifiers. The system is designed to enable (1) entering and deleting of both terms and relationships in small segments since all interconnections among terms are not expected to be known at one time; (2) searching by particular relationships to a particular term as well as by all relationships to that term; (3) orderly and legible formatting of the threading results; and (4) performance at reasonable speeds. Details of the program implementation on the RPC-4000 are given. Author (TAB)

N68-32902# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
PROGRAM LIBRARY FOR THE 103 ELECTRONIC COMPUTER
27 Jun. 1967 18 p Transl. into ENGLISH from K'o Hsueh Ch'u Pan She (Peking), 1965 p 41-63, 76-83, 93-103, 115-120, 141-149, 167-171
(FTD-HT-67-459; AD-671658)

The book treats principally of the standard subroutines and programs available for the 103 electronic digital computer which is patterned after the Russian-built M-3 small electronic digital computer. This is a revised edition of the original publication which appeared in June 1961. Subroutines are provided for the solution

of sin X and cos X, arc sin X, TG X, arc TG X, 1/E squared, 1n X, square root of X, decimal-to-binary-to-decimal conversion, SH X, and CH X. Standard programs are provided for solving the more common of the classical mathematical problems such as the Runge–Kutta method for solving ordinary differential equations, Simpson's differentiation method, etc. A few of the service routines are introduced, together with a program library for the 103 digital computer. The use of floating-point operations in the 103 digital computer is mentioned, and a floating-point program library, with associated subroutines, is detailed therein. The appendix contains a brief introduction to the 103 digital computer, instruction format, and a table showing the contents of registers at machine halts. TAB

N68-32914# Naval Weapons Lab., Dahlgren, Va.
ELEMENTARY INDEFINITE INTEGRATION THEORY FOR THE COMPUTER
Alfred H. Morris, Jr. Apr. 1968 42 p refs
(NWL-TR-2152; AD-671829)

Various algebraic properties of the indefinite Riemann integral that are appropriate for its use on the computer are examined. From this analysis it is seen that the operation of the integral on certain simply described families of functions, called invariant algebras, indicates how it must also act on more complex families of maps. Several examples of the theory are presented, illustrating among other things the relationship existing between integrals of certain types of hypergeometric functions and the integrals of the exponential and trigonometric functions. Author (TAB)

N68-32915# Naval Weapons Lab., Dahlgren, Va.
A PROGRAMMING GUIDE TO NOVACOM, A STRETCH COMPUTER PROGRAM FOR NON-ORTHOGONAL ANALYSIS OF VARIANCE AND COVARIANCE
Travis L. Herring Feb. 1968 219 p refs
(NWL-TR-2137; AD-671828)

The report gives detailed operating and programming maintenance documentation for NOVACOM, a computer program for non-orthogonal analysis of variance and covariance. It is suggested that this document be used in conjunction with AD-669 899. Chapters 3 - 5 of this report contain information pertinent to the use of NOVACOM: the procedure for input preparation, an explanation of program output, program limitations and restrictions, and a sample problem. Chapters 6 - 12 are more or less a maintenance guide. These chapters give detailed documentation of key areas of the program and contain information which will facilitate program maintenance, modification, and/or conversion to another computer system. The NOVACOM program is operational on an IBM 7030 computer. It is coded entirely in FORTRAN IV except for two minor utility subroutines which are coded in assembly language. The NOVACOM program is well suited for large scale digital computers with high-speed auxiliary storage. TAB

N68-32940# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
DESIGN OF CONTROL CIRCUITS ON TUBES WITH COLD CATHODE FOR A SELF-ADJUSTING MATHEMATICAL MACHINE [POSTROYENIYE TSEPEY UPRAVLENIYA NA LAMPAKH S KHOLODNYM KATODOM DLYA SAMONASTRAIVAYUSHCHEYSYA MATEMATICHESKOY MASHINY]
G. I. Grezdov and Yu. P. Kosmach 3 Nov. 1967 13 p refs
Transl. into ENGLISH from Akad. Nauk Ukr. RSR, Inst. Kibernetiki, Mat. Modelirobaniye i Teoriya Elektr. Tsepey (Kiev), no. 3, 1965 p 155-162
(FTD-MT-24-317-67; AD-671653)

Logical elements and units are required for new modeling devices of the algorithmic type, in which the process of problem solution is performed by a previously established program and the performance of this algorith is provided by a control device. Such devices include, in particular, self-adjusting mathematical models which solve problems with unknown parameters. In ordinary models, the control device is made of relays, step selectors and other electromechanical elements. This article analyzes the possibility of designing a control device for modeling devices of the algorithmic type on the basis of cold cathode tubes. The following circuits are described: pulse-shaper, coincidence circuits with 2 or more input signals, OR circuits, a register, a conversion circuit, and a circuit for connection of a digital display. TAB

N68-32959# Defense Communications Agency, Washington, D. C. National Military Command System Support Center.
DATA TRANSMISSION SYSTEM (TELTAP 2): GENERAL DESCRIPTION, OPERATOR'S MANUAL AND PROGRAM DESCRIPTION
Lester R. Straub 5 Mar. 1968 59 p
(CSM-7A-67; AD-671865)

Telephone Tape (TELTAP II) is a software system designed to provide high-speed data transmission capabilities to and from a remote data processing center. The system transmits data for a magnetic tape station via a Control Data 8090 computer system, utilizing a CDC 8529 Data Set Controller to allow computer control of the transmission hardware. An encrypting device is used for security purposes. TELTAP II provides for transmitting any data capable of being recorded on magnetic tape in physical records not to exceed 3000 six-bit characters in length. The computer operator communicates by a direct line telephone between terminals to coordinate data transmissions. The program provides an effective data transfer rate of approximately 78.4/79.6 to 2400/4920 characters per second. This effective rate is dependent on the number of characters in each tape block (the longer records being more efficient due to fewer inter-record gaps on tape), and if the program has to perform its own pre/post processing (Packing/Unpacking). The program also provides a recovery procedure in the event that the communications equipment losses sync, and manual intervention becomes necessary. Error detection is included to minimize errors. This is done both in the transmission of data and in the handling of magnetic tape input/output. Author (TAB)

N68-32965# Grumman Aircraft Engineering Corp., Bethpage, N. Y. Research Dept.
ON APPLICATIONS OF THE MIN-ALL ALGORITHM
G. E. Taylor Aug. 1968 23 p refs
(RM-423)

A procedure was developed for obtaining the solution to the large class of problems that can be formulated in terms of locating the minimum of a function. This procedure, a combination of a philosophy of analysis and a new computer program, has been applied to a variety of problems. Some of the lessons learned through this testing are described. Author

N68-32992# Pennsylvania Univ., Philadelphia. Moore School of Electrical Engineering.
A FILE SYSTEM FOR A PROBLEM SOLVING FACILITY
David Kai-Mei Hsiao (Ph.D. Thesis) 1968 180 p refs
(Contract Nonr-551(40))
(Rept.-68-33; AD-671826)

In order to create a genuine sense of information-sharing, a problem-solving facility must be able to protect the privacy of a users files and make information-sharing voluntary. Once a user learns that his files would be free from the invasion of privacy, he may gain confidence in using the facility. The objective of this dissertation is to discuss a pilot model for demonstrating the feasibility of a file system (1) that has the capability of managing files and providing system components to a users program, and the potential to grow in terms of data, programs and file management functions; (2) that can protect the privacy of a users information; (3) that enables a file owner to share gradually and voluntarily his

information with others. The solution to (1) leads to the development of a centralized file organization and a centralized file system with the capability of automatic file creation, generation and maintenance. The solution to (2) leads to the incorporation of a protection mechanism in the file system. The solution to (3) results in the concept of file ownership and its authority. Author (TAB)

N68-33046# Radio Corp. of America, Princeton, N. J.
ON REPRESENTATIONS AND MODELING IN PROBLEM SOLVING AND ON FUTURE DIRECTIONS FOR INTELLIGENT SYSTEMS
Saul Amarel Jun. 1968 31 p refs
(Contract F44620-68-C-0012)
(SR-2; AFOSR-68-1580; AD-671992)

The problem of representations in problem solving is introduced, and its significance for progress in machine intelligence is discussed. The related problem of forming and using models in machine problem solving is also discussed. Some current research in these areas is reviewed, and open problems are outlined. In addition, more general comments on the state of the art in artificial intelligence are made from the viewpoint of a designer of complex, computer-based, information processing systems. The question of establishing a conceptual framework for intelligent problem solving that would enable designers to generalize and transfer results from specific research projects in the area into their real life situations receives special attention. Author (TAB)

N68-33105# Michigan Univ., Ann Arbor.
THE DATA CONCENTRATOR
David Mills May 1968 123 p refs
(Contract DA-49-083-OSA-3050; ARPA Order-716)
(TR-8; AD-671684)

This report describes a programmable transmission control unit which is attached to an IBM System/360 Model 67 machine operated in a timeshared environment. Called the Data Concentrator, this device provides service for AT+T teletype equipment, IBM typewriter terminal equipment, and remotely located computer equipment interconnected with serial-synchronous transmission data sets. The Data Concentrator is constructed of several different kinds of line adapters which connect on one hand to all types of AT+T data sets available for use on the switched-network, and on the other to a modified Digital Equipment Corporation PDP-8 computer. Connection is made between the System/360 multiplex channel and the PDP-8 by means of a special interface which provides a direct connection to the control lines emanating from the multiplex channel and presents a behavior compatible with other IBM transmission control units. The programmable nature of the Data Concentrator provides an unusually rich variety in transmission protocol and operational modes for its attached terminal equipment yet with minimal modifications to extant System/360 control programs. Author (TAB)

N68-33137*# Arizona State Univ., Tempe. College of Engineering Sciences.
DEFINITIONS AND PROCEDURES EMPLOYED IN THE GERT EXCLUSIVE-OR PROGRAM
Phillip C. Ishmael and A. Alan B. Pritsker [1968] 69 p refs Submitted for publication
(Grant NGR-03-001-034)
(NASA-CR-96294) CFSTI: HC $3.00/MF $0.65 CSCL 09B

This report describes the definitions of the variables and the techniques used in a digital computer program for analyzing GERT networks which contain nodes of the EXCLUSIVE-OR type and branches which have both a probability and a time associated with them. The time associated with a branch can be a random variable. The program calculates the probability, the expected time and the variance in the time to go from each source node of the GERT network to each sink node. Programs have been written in FORTRAN II and FORTRAN IV and have been exercised on the IBM 1130, GE 225 and CDC 3400 computers. This report details the methods used in these programs. Emphasis has been placed on storage conservation. Methods for determining the loops and paths of a network are described. The equations necessary to calculate the values associated with the topology equation from loop and path values are presented. Flow charts and FORTRAN listings are given for each subprogram. A method for obtaining results for large networks by segmenting the network is presented at the end of this report. Author

N68-33291# Advisory Group for Aerospace Research and Development, Paris (France).
AIR AND SPACE BORNE COMPUTERS
Jun. 1968 43 p refs *Its* 31st Lecture Ser.
(AGARD-ES-1) CFSTI: HC $3.00/MF $0.65

Design and logistic criteria for advanced airborne and spaceborne computers are discussed, and various design tradeoffs are analyzed. Techniques for developing optimum man-computer relationships are examined, and the implications of microprogramming are considered. Microelectronics is discussed in relation to such developments as large scale integration, using metal oxide semiconductors or bipolar devices; signal processing, onboard checkout, and system automation. Consideration is also given to optimum packaging approaches, new computing devices, and new memory and storage techniques. The problems involved in selecting a computer system are examined. M.G.J.

N68-33447# Nuklearni Institut Jozef Stefan, Ljubljana (Yugoslavia).
A PARSING CONCEPT FOR A HIGH-LEVEL PROGRAMMING LANGUAGE
A. P. Zeleznikar and F. Decar Jun. 1968 9 p refs Presented at the 3d Intern. Meeting on Electron. and Automation, Herceg Novi, Yugoslavia, 24–29 Jun. 1968
(NIJS-R-534) CFSTI: HC $3.00/MF $0.65

A high level programming language is a concrete formal language, the syntax of which being described by a system of metasyntactic expressions. Hence, a formal language is generated by a grammar being structurally dependent, in general. The solution of parsing problem can be divided in two parts. First, the given grammar is transformed to an equivalent, structurally nondependent grammar, and then for this grammar a simple parsing algorithm concept is derived. The method described provides the parsing of any programming language if syntax of this langusge is determined by a Backus system. Author

N68-33471# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
AN INTRODUCTION TO ANALOG COMPUTERS
Hsien-Min Liu 1 Sep. 1967 9 p Transl. into ENGLISH from Tien-Tzu Chi-Shu (Shanghai), no. 6, 1965 p 31–32
(FTD-HT-67-241; AD-671741)

The report discusses the design principle of analog computers, including an operation amplifier and typical circuits. Author (TAB)

N68-33475# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
THE DEVELOPMENT OF AN ELECTRONIC ROOT SOLVER
Bin-Wei Shuech and Jong-en You 27 Jun. 1967 16 p refs Transl. into ENGLISH from Tzu Tung Hua Hsueh Pao (Communist China), v. 3, no. 3, 1965 p 151–157
(FTD-HT-67-418; AD-671745)

The authors introduce an operational principle for construction of an electronic root solver is based on the principles of

Lukaszewicz. A 400-cps sinusoidal signal is fed to the 6 root solving circuits, each having a feedback network capable of producing a phase shift of 90 deg. The tuned amplifier is used to improve the null-detection sensitivity. The authors claim that the instrument is capable of solving algebraic equations involving real coefficients up to the sixth-order with an error lower than 5%, if constructed based on their principle. The principle also applies to other root solving instruments for algebraic equations of higher order.
Author (TAB)

N68-33484 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
CYBERNETIC TECHNOLOGY (SELECTED ARTICLES)
1 Sep. 1967 41 p refs Transl. into ENGLISH from the book "Kiberneticheskaya Tekhnika" Kiev, Izd. Naukova Dumka, 1965 p 19–41, 59–70, 102–118
(FTD-MT-24-134-67; AD-669430)

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N68-33485 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
STAND FOR SAMPLING MATRICES OF MAGNETIC MEMORY ELEMENTS ON THIN FILMS [STEND DLYA OTBORA MATRITS MAGNITIYKH ZAPOMINAYUSHCHIKH ELEMENTOV NA TONKIKH PLENKAKH]
V. M. Galanskiy and Yu. V. Ostapenko *In its* Cybernetic Technol. 1 Sep. 1967 p 1–8 refs (See N68-33484 20-08)

Processing of thin-film matrices for operational memory devices of computers and other related equipment is discussed. Matrices are checked for four threshold characteristics (writing current "1" erasing current "1", writing current "0", and erasing current "0"). These criteria are then employed to determine current tolerances for the matrix and memory unit as a whole. The characteristics are tested on a pulse stand under simulated conditions. Various test techniques are considered. The pulse routine is shaped by a generator. The results of the test are automatically recorded. The stand consists essentially of the generator which provides the program required for the testing of the threshold characteristics, a measuring unit, a broadband amplifier, a scope, an automatic recorder, and a triggering generator. The pulse amplitude is formed by gated power transistors. Leading edge rise time is no more than 50 nsec. This test stand has been used for work with magnetic matrices and memory cell quality control.
Author

N68-33486 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
TOLERANCES OF CONTROL CURRENTS IN A CRYOTHRONE MEMORY UNIT [DOPUSKI NA UPRAVLYAYOSHCHIYE TOKI V KRIOTRONNOM ZAPOMINAYUSHCHEM USTROYSTVE]
I. D. Voytovich *In its* Cybernetic Technol. 1 Sep. 1967 p 9–19 refs (See N68-33483 20-08)

Tolerances in memory currents are discussed, including tolerances in recording discharge current amplitude, address recording pulse amplitude, discharge readout pulse amplitude, and address readout pulse amplitude.
Author

N68-33487 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
INCREASING FERRITE MEMORY UNIT ACCESS RATE, BY IMPROVING DISCHARGE CIRCUITS [POVYSHCNIYE CHASTOTY OBRASHCHENIYA K FERRITOVOMU ZAPOMINAYUSHCHEMU USTROYSTVU PUTEM SOVERSHENSTOVOVANIYA RAZRYADNYKH TSEPEY]
N. K. Babenko and A. D. Bekh *In its* Cybernetic Technol. 1 Sep. 1967 p 21–27 refs (See N68-33484 20-08)

Increased memory element response speed was investigated with particular attention to maximum operating cycles for address and discharge circuitry. Increased response speeds for direct-sample ferrite storage devices are sought primarily through improvements in the discharge circuitry. The effects of discharge-induced noise amplitude on useful signal-to-noise ratios are discussed in detail together with storage element sensitivity and response speed. The discharge noise may be reduced by separating the signal coil into two sections and coupling them in phase opposition for purposes of discharge noise compensation. This principle is examined at length. Read-out amplifier circuit diagrams are considered which provide for a reduced effect of discharge noise on cycle duration. The most promising circuits are of the differential amplifier type in which the maximum cycle of the storage unit is determined only by the cycle of the memory core. The circuit diagram of a reading amplifier having an operating cycle smaller than that of the signal coil is analyzed in detail. The response speed of large capacity ferrite memories is shown to be limited by the operating cycle of the read-out amplifier. The use of time-selection circuits at the amplifier input makes it possible to design a memory with a cycle equal to the maximum cycle of the ferrite core. By dividing the signal winding into parts, a reduction in the operating cycle of the ferrite core can be achieved.
Author

N68-33488 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
CONCERNING THE QUESTION OF USING THE HAMMING CODE TO INCREASE ZU RELIABILITY ON MAGNETIC TAPE [K VOPROSU O PRIMENENII KODA KHEMMINGA DLYA POVYSHENIYA NADEZHNOSTI ZU NA MAGNITNOY LENTE]
Yu. G. Savchenko and L. V. Adamovich *In its* Cybernetic Technol. 1 Sep. 1967 p 29–34 refs (See N68-33484 20-08)

Existing methods for improving reliability of digital automatons may be divided into two broad classes: methods based on information redundancy or those based on design redundancy. The conditional nature of this breakdown is discussed briefly. It is pointed out that while error-dectecting-and-correcting codes for data transmission have been widely discussed in the literature, the application of such codes for the purpose of improving the reliability of magnetic tape storage devices is obstructed by the lack of coding and decoding arrangements and circuits. Although modern magnetic tape storage devices use back-up or stand-by techniques, this method suffers from excessively high redundancy (two-fold). One method for achieving better reliability for such memories is found by using the Hamming information code. An analysis is given of the design redundancy which results from the use of this method, i.e., the design and execution of coding and decoding systems for a Hamming code incorporating the correction of single and binary errors.
Author

N68-33489 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
PRINCIPLES OF CONSTRUCTION OF A DIGITAL CORRELATOR [PRINTSIPY POSTROYENIYA TSIFROVOGO KORRELYATORA]

R. Ya. Chernyak, Yu. G. Sal'kov, and G. I. Zlobin *In its* Cybernetic Technol. 1 Sep. 1967 p 35–39 (See N68-33484 20-08)

Fundamental concepts on the construction of a digital correlator are presented. The efficient separation of computing operations between the correlator and the computer is studied. The main characteristics of the digital correlator are: a binary system; a fixed point, with computed results in whole and fractional terms; 10 digit initial data feed, and computation results of 30; 200 cps operating frequency; 400 multiplications speed of response, plus 400 additions per second; and 860 triodes. Author

09 ELECTRONIC EQUIPMENT

Includes electronic test equipment and maintainability; component parts, e.g., electron tubes, tunnel diodes, transistors; integrated circuitry; microminiaturization. For basic research see: 10 Electronics. For related information see also: 07 Communications and 21 Navigation.

N68-32248 National Lending Library for Science and Technology, Boston Spa (England).
CALCULATION OF DYNAMIC PROCESSES IN A SYSTEM, TAKING INTO ACCOUNT ASYNCHRONOUS LOADING [RASCHET DINAMICHESKIKH PROTSESSOV V SISTEME S UCHETOM ASINKHRONNOI NAGRUZKI]
D. A. Gorodskii May 1968 20 p refs Transl. into ENGLISH from Elektrichestvo (Moscow), no. 10, 1967 p 7–13
(RTS-4582) Available from Natl. Lending Library, Boston Spa, Engl.: 17s 6d

Basic principles of the theory of machines with longitudinal-transverse excitation are discussed; and general calculations as well as calculations for asynchronous motors are detailed. Special features are noted for the calculation of electromechanical transitional processes in asynchronous motors by a progressive intervals method, and reduction of errors resulting from this method is considered. Determination of voltage at the nodal point is also discussed. M.W.R.

N68-32249 National Lending Library for Science and Technology, Boston Spa (England).
SOME PROBLEMS RELATED TO THE DESIGN OF HYSTERESIS (INDUCTION) MOTORS [NEKOTORYE VOPROSY PROEKTIROVANIYA GISTERESISNOGO DVIGATELYA]
N. Z. Mastyaev and I. N. Orlov Feb. 1968 23 p refs Transl. into ENGLISH from Elektrichestvo (Moscow), no. 10, 1963 p 39–46
(RTS-3068) Available from Natl. Lending Library, Boston Spa, Engl.: 17s 6d

Conditions required for the optimal design of a hysteresis or induction motor are reviewed, and a method is outlined for attaining maximum efficiency at the nominal power input. The main problem is considered the determination of the relative thickness of the active layer of the rotor and the magnetic flux density in the airgap. The machine constant of a hysteresis (induction) motor operating at maximum efficiency is developed, and selection of the electromagnetic loads is considered. Dependence of the electromagnetic loads in the motor upon the amount of heat developed in the stator winding is treated. Basic dimensions of the stator are determined, and attention is given to the selection of the material and the dimensions of the active part of the rotor as well as to determination of the basic parameters of the motor. M.W.R.

N68-32251*# North American Rockwell Corp., Anaheim, Calif.
PROCESS TECHNIQUES STUDY OF INTEGRATED CIRCUITS Interim Scientific Report No. 1
James E. Meinhard May 1968 207 p refs
(Contract NAS12-4)
(NASA-CR-86091; C5-1471.12/501) CFSTI: HC $3.00/MF $0.65 CSCL 09A

In developing advanced process techniques for fabricating high reliability silicon integrated circuits, an instrumental investigation of planar processing techniques was conducted with special emphasis on device surfaces for discovering and correcting failure modes. These modes are categorized as effects of gas ambients during fabrication, and of trace materials deposited during fabrication; application of photoresist and photoetch techniques; oxide processing; scribing; contact attachment; and effects of contact between the processing tools and the wafer during fabrication. Other studies were conducted pertaining to interactions between the silicon and the highly insulating material in contact with it, and to the effects of such interactions on integrated circuit performance, including long term drift. Supporting data on the overall program accomplishments are presented. Also discussed are the continuing activities related to determining failure mechanisms due to oxide passivation and those associated with packaging, and methods of formulating an instrumental capability profile. M.G.J.

N68-32296# Ion Physics Corp., Burlington, Mass.
HIGH VOLTAGE BREAKDOWN STUDY Quarterly Progress Report, 16 Nov. 1967–15 Feb. 1968
W. R. Bell, M. J. Mulcahy, F. Y. Tse, and A. Watson Jun. 1968 38 p
(Contract DA-28-043-AMC-00394(E); ARPA Order-517)
(ECOM-00394-13; QPR-13; AD-671693)

The results of four treatments are reported from a 32-block, 5-factor, full-factorial experiment now underway to investigate the main effects and interactions of the following factors: anode and cathode material (copper and aluminum), electrode treatment (hydrogen or vacuum fired), anode size and shape (Bruce or sphere). By a process of stacking, the effect of a transverse magnetic field, exposure and energy storage will also be investigated. Author (TAB)

N68-32315 National Lending Library for Science and Technology, Boston Spa (England).
TRANSIENT PROCESS IN THE ASYNCHRONOUS MOTORS WITH CONTROLLED SEMI-CONDUCTOR COMMUTATOR [PEREKHODNYE PROTSESSY V ASYNKHRONNYKH MASHINAKH S UPRAVLAYEMYM POLUPROVODNIKOVYM KOMMUTATOROM]
Sh. I. Lutudze Feb. 1968 16 p refs Transl. into ENGLISH from Elektrichestvo (USSR), v. 7, 1966 p 39–44
(RTS-4377) Available from Natl. Lending Library, Boston Spa, Engl.: 15s

An analytical method is presented for calculating single-phase and two-phase asymmetric regimes in asynchronous electric motors with controlled semiconductor commutators (CSC). Consideration is given first to the two-phase regime, with the single-phase regarded as a partial case of the two-phase regime. Transient process equations for the total alternating asymmetric modes are obtained from the general equations of the motor with asymmetric windings. To simplify the equations, the coordinate system is chosen to be stationary with regard to the rotor. Calculations are also included on the transient processes of the three-phase CSC asynchronous exciter with bridge connection. M.G.J.

N68-32328*# General Precision, Inc., Glendale, Calif. Systems Div.
RELIABILITY ASSURANCE: STUDY OF FAILURE AND RELIABILITY OF MICROELECTRONIC DEVICES Quarterly Report, 1 Apr.–30 Jun. 1968

9 Jul. 1968 27 p (Contract NAS12-72)
(NASA-CR-96229; TR-1-1529; QR-11) CFSTI: HC $3.00/MF $0.65 CSCL 09A

Five hundred microelectronic test specimens were received for reliability assurance studies. Effort was concentrated on preparing the detailed test procedure and developing and verifying test methods. Concurrently, the specimens were inspected, grouped and serialized and initial dc and pulse measurements were completed. The vibration/shock mounting fixture has been designed. The motherboards for dc measurements at temperature extremes were received and 2 scanner cables assembled. Author

N68-32328 Rochester Univ., N. Y.
A STUDY OF THE PHYSICAL MECHANISM OF THE CHARGISTOR
Tzu Fann Shao (Ph.D. Thesis) 1968 104 p
Available from Univ. Microfilms: HC $5.20/MF $3.00 Order No. 67-13648

The chargistor, basically a three terminal semiconductor amplifying device, was first reported by H. N. Yu in 1961, but the physical mechanism of its operation was not clearly understood. In this study, the exact physical structure of the chargistor has been experimentally identified to be different from that reported by Yu. The amplifying mechanism of the device can be described in terms of the phenomena of minority carrier injection and minority carrier exclusion. The relatively high output impedance of the chargistor is a direct result of the exclusion phenomenon. The current gain, as measured drops from 2 to 3 in the low current range to about unity in the high current range. This variation can be qualitatively accounted for by the expected variation of the injection and transport efficiencies of the device as functions of injection level. The voltage-current transfer function has been measured over a limited range. It showed a square relation in the high current range. The origin of this relation is not yet clear but it is suggested that a modified Jonscher's model may be applicable here. The chargistor may also show a negative resistance effect of unknown origin. Dissert. Abstr.

N68-32359 National Lending Library for Science and Technology, Boston Spa (England).
OSCILLOGRAPHIC METHOD OF TESTING INTRINSICALLY SAFE ELECTRICAL CIRCUITS [OSCYLOGRAFICZNA METODA BADAN ISKROBEZPIECZNOSCI OBWODOW ELEKTRYCZNYCH]
A. Grzywak and W. Swider 31 Oct. 1967 21 p refs Transl. into ENGLISH from Prace Zakladow Konstrukcyjno-Mechanizacyjnych Przemyslu Weglowego (Czechoslovakia), v. 55, 1966 11 p
(SMRE-TRANS-5523) Available from Natl. Lending Library, Boston Spa, Engl.

This paper describes the testing of intrinsically safe electrical circuits by an oscillographic method. The measurements made suggest that it is possible to replace the methods employing breakflash apparatus by oscillographic tests, the purpose of which would be to determine the energy released from an electric circuit at contacts similar to those used in breakflash equipment. The principles of this theoretical measuring method are described here as well as methods of measurement. To illustrate the possibility of using oscillographic tests the results of measurements of the energy released by various electrical circuits are given. Author

N68-32365# Naval Research Lab., Washington, D. C. Microwave Antennas and Components Branch.
PHASE-SHIFT ENHANCEMENT BY MODE-SUPPRESSION TECHNIQUES Interim Report
M. L. Reuss, Jr. 30 Apr. 1968 12 p refs
(NRL-6677; AD-671790)

An X-band study was made of a ferrite phase shifter consisting of a ferrite rod filling the waveguide height and subject to an axial (longitudinal) applied magnetic field. The phase shift produced by this configuration depends on the relative contributions of positive and negative phase-shift modes, each of which dominates in a given section of the ferrite-loaded waveguide. Initial results indicate that the relative phase shift of the plain ferrite-loaded waveguide can be increased by 20% or more through the use of mode suppressors that act predominantly on the negative phase-shift mode. A secondary effect produced by these suppressors is the reduction of the insertion-loss peaks common to this class of phase shifters. Author (TAB)

N68-32383# Hughes Research Labs., Malibu, Calif.
MAGNETIC COMPRESSION OF ELECTRON BEAMS Final Report, 1 Jul. 1965–31 Jan. 1968
Kurt Amboss Jun. 1968 186 p refs
(Contract DA-28-043-AMC-01463(E))
(ECOM-01463-F; FR-10; AD-671643)

The problem of compressing an electron beam by magnetic fields was investigated theoretically and experimentally. The feasibility of magnetic compression was established and demonstrated by passing a perveance 0.0000054A/V to the 3/2 power beam, compressed in area by a factor of 1000, through a drift tube 0.014 in. in diameter and 1 in. long, with 95% transmission. The success of the magnetic compression technique rests on the hitherto unsuspected ability of the beam to damp out undulations and smooth out structure. A quantitative explanation of the mechanism, which does not involve electron-electron collisions, is put forward. Three qualitative theories are discussed: (1) a simple semiempirical theory to be used in engineering calculation of the required confining field; (2) a more elaborate theory which is an extension of a statistical theory by Pierce and Walker and is valid for the downstream region where the beam has become featureless; and (3) a nonlinear electron optical theory which describes the electron flow close to the gun. Author (TAB)

N68-32386 National Lending Library for Science and Technology, Boston Spa (England).
MEASUREMENTS OF THE NOISE FACTOR F IN HIGH-FREQUENCY TRANSISTORS
D. Rutkowski, L. Spiralski, and E. Ziajka 23 Nov. 1967 6 p refs Transl. into ENGLISH from Przegl. Elektron. (Poland), v. 8, no. 3, 1967 p 120–124 *Its* Transl. No. 2431
Available from Natl. Lending Library, Boston Spa, Engl.

The article describes the construction of an instrument for measuring at spot frequencies the noise factor F of transistors which operate at radio frequencies. It also gives the results of measurements of the noise factor of transistors made in Poland. Noise limits the application of transistors in the stages of amplifiers used for amplifying very low signals. A transistor generates three types of noise: thermal noise, noise of the emitter-collector junction and the noise resulting from the change of carrier density. The Q-factor of transistors corresponding to noise can be measured by a noise factor F. The noise power of the transistor is dependent upon the properties of the transducer itself as well as the temperature and band width of the networks which operate together with the transistor. This is why when measuring the noise factor F one also states the value of the band width, temperature and the source impedance. Author

N68-32404# Army Electronics Command, Fort Monmouth, N. J.
INVESTIGATIONS OF TE_{01} MODE CIRCULAR WAVEGUIDE TRANSDUCER AT MILLIMETER WAVELENGTHS
Leonard E. Moore May 1968 45 p refs
(ECOM-2975; AD-671597)

Three different design approaches to achieve a broadband, low-loss, and well-matched TE sub 10 rectangular to TE sub 01 circular waveguide transducer for millimeter wavelengths were

investigated. A model of each type was fabricated and tested. Construction details are given, and test results on each model are discussed. A design was achieved that provides a 20 percent bandwidth over the frequency range 31 to 38 GHz. Spurious unwanted modes are suppressed to give a mode purity in excess of 20 dB. Maximum VSWR values do not exceed 1.18. The insertion loss was found to be higher than desired; however, it is believed this could be reduced by the utilization of a one piece mandrel in the electroforming process. Author (TAB)

N68-32423# Electrotechnical Lab., Tokyo (Japan).
RESEARCH ON RELIABILITY OF ELECTRONIC COMPONENT: THE CUMULATIVE DEGRADATION RULE AND ACCELERATED LIFE TEST
Hiroshi Shiomi Jan. 1968 75 p refs In Japanese; ENGLISH summary *Its* No. 681
CFSTI: HC $3.00/MF $0.65

Fundamental aspects of component reliability are discussed, especially the cumulative degradation model and its application to service life estimates and accelerated life tests. The application of the generalized Miner equation to estimations of service life and degradation of components is analyzed. The efficiency of techniques for estimating the service life versus stress relationship is examined, and deficiencies in such ordinary life tests as the step stress test are investigated. K.W.

N68-32431# Institut fur Plasmaphysik G.M.B.H., Garching (West Germany).
PRESSURIZED SWITCHING UNIT DESIGNED TO START AND TO CROWBAR A TURBULENCE HEATING EXPERIMENT
G. Klement and G. Mueller Jun. 1968 37 p refs Presented at the 5th Symp. on Fusion Technol., Oxford, 2–5 Jul. 1968
(IPP-4/52) CFSTI: HC $3.00/MF $0.65

A start spark gap and a ferrite decoupled crowbar gap, moulded together in an epoxy resin pressure chamber of outer size 20 × 14 × 10 cm, are described. As arranged in this experiment, the main bank of which has a double transit time of only 20 nsec, the start gap must have a jitter of less than 10 nsec over a range of about 1:3, when triggered by a 50 KV pulse voltage of 80 nsec rise time. The inductance of the start gap is 35 nH, while the crowbar gap has a saturated inductance of 180 nH, which could be reduced by modifying the trigger circuit. The experience in testing and operating 60 units, with the associated trigger circuits and such data as delay, jitter, prefiring rate and stability to voltage transients, is reported. Investigations on pulse breakdown, depending on trigger voltage characteristics up to ten atmospheres, and the influence of gap spacing are discussed, with regard to spark gap development. Potential plots of some static and triggered cases are given. Author

N68-32434# Army Electronics Command, Fort Monmouth, N. J.
TRAVELING WAVE AMPLIFICATION BY DRIFTING CARRIERS IN SEMICONDUCTORS
Bruno Zotter Apr. 1968 40 p refs
(ECOM-2958; AD-671602)

The dispersion relation for a carrier wave in a semiconductor interacting with a circuit wave is rederived and solved numerically. Limitations of the theoretical model are discussed. The conditions for maximum gain in a traveling-wave amplifier are found for a number of semiconductor materials such as germanium, silicon, gallium arsenide and indium antimonide. Several discrepancies found in an earlier work are investigated. Author (TAB)

N68-32453 National Lending Library for Science and Technology, Boston Spa (England).
THE USE OF THE LAMP DKST-6000 FOR BIOCHEMICAL EXPERIMENTS [ISPOLZOVANIYE LAMPY DKST-6000 DLA BIOKHEMICHESKIKH EKSPERIMENTOU]
L. F. Afanasev Jan. 1968 6 p Transl. into ENGLISH from Svetotekhnika (Moscow), v. 3, no. 12, 1966 p 12–14
(RTS-4820) Available from Natl. Lending Library, Boston Spa, Engl. 7s 6d

A heat filter in the form of a cylindrical jacket was developed for the DSKT-6000 water-cooled tubular xenon lamp in order to provide shielding from infrared radiation. A solution of copper sulfate of 10% concentration was used for the filter, and the distilled water required for cooling was circulated through this solution. Such a filter permits use of the lamp in biochemical experiments. M.W.R.

N68-32465# Aerospace Research Labs., Wright-Patterson AFB, Ohio.
SURVEY OF EFFECT OF SURFACE PROPERTIES ON ANODE EROSION
N. S. Rasor Apr. 1968 29 p refs
(ARL-68-0069; AD-671503)

Anode erosion is a serious problem in high power electric arcs and appears to be due primarily to intense local heating. Three means are considered for amelioration: improved heat transfer from the anode spot, broadening of the anode spot (decreased power density), and reduction of total anode power dissipation. Low work function patches may create preferred arc attachment points. Surface composition, structure, and preparation can have major influence, and means are discussed for tailoring anode surface properties. Author (TAB)

N68-32466 National Lending Library for Science and Technology, Boston Spa (England).
ACTIVE RC FILTER, REALIZATION BY MEANS OF INVERSE FEEDBACK AMPLIFIER
H. Rempke 5 Dec. 1967 16 p refs Transl. into ENGLISH from Frequenz (W. Berlin), v. 21, no. 6, 1967 p 178–183 *Its* Transl. No. 2441
Available from Natl. Lending Library, Boston Spa, Engl.

The realisation of a certain transfer function is possible by means of various active elements and passive R-C networks. In describing the various active circuits their essential characteristics are outlined. In particular, an active R-C filter of low temperature dependence ($\leq 100.10^{-6}$ per deg C) is described. It is realised by an amplifier with frequency-dependent feedback. Frequency determining is a double T-network characterized by the fact that its transfer function does not exhibit a zero for any frequency. Author

N68-32497 National Lending Library for Science and Technology, Boston Spa (England).
EXPERIMENTAL STUDY OF THE DIFFERENT DAMPING CIRCUITS OF AN ALTERNATOR. MEASUREMENT OF THE TRANSVERSE REACTANCE [ETUDE EXPERIMENTALE DES DIFFERENTS CIRCUITS AMORTISSEURS D'UN ALTERNATEUR. MESURE DE LA REACTANCE TRANSVERSALE]
Marcel Sabatier 26 Sep. 1967 56 p refs Transl. into ENGLISH from Rev. Gen. Elec. (Paris), v. 70, no. 8, 1961 p 395–412 In FRENCH and ENGLISH
(EE-TRANS-1589) Available from Natl. Lending Library, Boston Spa, Engl.

The first part of the study compares the effectiveness of several types of alternator damping circuits in unbalanced operation, especially under short circuit conditions. Emphasized is the

comparison of the transverse damper with the complete damper. Connected to these questions is the investigation into the damping of the free or forced oscillations in the rotors of alternators operating in parallel. These oscillations are defined by the variations in the internal phase displacment angle of the alternators. The third part of the article is devoted to the measurement of the steady state displacement angle by electronic chronometer, and the application of this method to an accurate measurement of the transverse reactance of the alternators. Author

N68-32533 National Lending Library for Science and Technology, Boston Spa (England).
CONSTRUCTION, TESTING AND TRANSMISSION CHARACTERISTICS OF A H_{01}-WAVEGUIDE STRETCH FORMED BY DIELECTRIC-COATED ALUMINUM TUBING
H. Larsen, H. L. Hartmann, W. Jansen, and S. Sedlmair 4 Jul. 1968 52 p refs Transl. into ENGLISH from Frequenz (W. Berlin), v. 21, no. 11, Nov. 1967 p 344–355 and v. 21, no. 12, Dec. 1967 p 381–384 *Its* Transl. No. 2469
Available from Natl. Lending Library, Boston Spa, Engl.

Seven hundred meters of long-haul waveguide were assembled using aluminum tubing with dielectric lining and mode filters with metallized surfaces, to check whether this engineering concept meets the demands to be placed on a PCM transmission path. Attention was focused on two problems which had to be solved for this purpose: (1) The partial lengths coming from the production must be tested and evaluated with respect to their mechanical tolerances in a way that it can be decided whether the expected values of the conversion attenuations in the projected frequency range are acceptable; (2) On the basis of measurements on the 700-metre run of connected-up waveguide an extrapolation must be made as to the expected values of signal distortion and attenuation of a repeater section; The methods required for this purpose are explained. From measurements of the attenuation variations the conclusion could be made that the waveguide fitted with mode filters is sufficiently good. Author

N68-32534# Institut fur Plasmaphysik G.M.B.H., Garching (West Germany).
CROWBAR SYSTEM IN ISAR 1
E. van Mark and H. Wedler Jun. 1968 29 p refs
(IPP-4/59) CFSTI: HC $3.00/MF $0.65

The arrangement of the crowbar system in the 2.7 MJ capacitor bank Isar I is described. Special care went into the conception of a trigger system consisting of a swinging trigatron, master spark gap and 18 two-stage Marx generators. Also included are described precautions against prefiring of the crowbar spark gaps and the loading of a crowbar spark gap due to prefiring. Author

N68-32583 National Lending Library for Science and Technology, Boston Spa (England).
IMPROVED SYNCHRONOUS INDUCTION MOTORS [USOVERSHENSTVOVANNYE SINKHRONNYE REAKTIVNEY DVIGATELI]
E. V. Kononenko, A. N. Aifert, A. L. Kislitsyn, B. P. Garganeev, and A. F. Fink Jun 1968 11 p *refs* Transl. into ENGLISH from Elektrotekhnika, v. 6, Jun. 1967 p 18–20
(RTS-4577) Available from Natl. Lending Library, Boston Spa, Engl. 7s 6d

The topic discussed is the power output that can be obtained from an improved synchronous induction motor of the same overall dimensions as an asynchronous motor. The results of a technical-economic analysis are also presented. Author

N68-32678 National Lending Library for Science and Technology, Boston Spa (England).
ENERGY STORAGE CAPACITORS
Wolfgang Held, Werner Kahl, Franz Josef Pollmeiner [1968] 21 p refs Transl. into ENGLISH from Siemens Z. (Berlin), v. 41, Nov. 1967 p 887–895
(M-12829) Available from Natl. Lending Library, Boston Spa, Engl.

Large energy storage capacitors for high charging voltages are described for present-day applications in physics and technology. They include, in addition to dc and smoothing capacitors, impulse capacitors slowly charged at low power and then rapidly discharged into the consumer at high power. Author

N68-32591# Army Mobility Equipment Command, Fort Belvoir, Va. Army Mobility Equipment Research and Development Center.
THE ELECTRON-OPTICAL PROPERTIES OF AN IMAGE CONVERTER
Ching-Kai Shen, Chou Ming, and Tze-Chueng Ni Apr. 1968 24 p refs Transl. into ENGLISH from Wu Li Hsueh Pao (Peking), v. 21, no. 2, 1965
(USAMERDC-T-1921-68; AD-671698)

The field distribution and electron-optical properties of an electrostatically-focused image converter with a plane cathode are determined precisely by means of a resistance network analogue and numerical computation. The axial potential distribution can be expressed by the empirical formula phi = A sinh kz. Graphs are given, showing the dependence of coefficients A, k, the position of gauss-image plane, and the linear magnification on inter-electrode spacing. An approximate formula for calculating the distortion-coefficient is derived, which agrees fairly well with experimental result. Design factors are discussed. Author (TAB)

N68-32608# Naval Avionics Facility, Indianapolis, Ind. Applied Research Dept.
STANDARD HARDWARE PROGRAM 60 MCPS IF AMPLIFIER MODULE
Leo F. Welsh 16 Apr. 1968 23 p
(NAFI-TR-1208; AD-671814)

The report describes a Standard Hardware Program (SHP) Size 2B module which contains a 60 Mcps I.F. amplifier with 80 db of gain. Included is an appendix which defines the requirements of the module in a format suitable for adaptation to a specification control drawing. Author (TAB)

N68-32613 National Lending Library for Science and Technology, Boston Spa (England).
EVALUATION OF THE OPERATIONAL RELIABILITY OF LARGE ELECTRONIC INSTALLATIONS
E. Schultze 2 Oct. 1967 15 p *ref* Transl. into ENGLISH from Hasler-Mitt., v. 25, no. 3, 1966 p 69–75 *Its* Transl. 2419
Available from Natl. Lending Library, Boston Spa, Engl.

The theory of reliability engineering developed over about the last ten years makes it possible in many cases to estimate in a relatively simple manner the operational reliability of electronic equipment comprising thousands of components, or alternatively to design such equipment so that its reliability reaches a certain value. The increasing importance of this new discipline makes it necessary for the responsible designer to become more familiar with it. In the present paper therefore an attempt is made to collect together the simplest concepts and formulae without giving their derivations. Although a complete understanding of the fundamentals requires a considerable knowledge of the theory of probability, the more important results should be capable of being understood and used by those having a limited knowledge of mathematics. Author

N68-32622# Harry Diamond Labs., Washington, D. C.
ELECTROACOUSTIC DELAY LINES FOR MICROWAVE FREQUENCIES
Frank Reggia and Ting H. Mak Mar. 1968 40 p refs
(HDL-TR-1382; AD-671689)

The paper describes techniques for the generation and propagation of elastic waves in the frequency range 1 to 3 GHz. These techniques include the design, fabrication, and evaluation of microwave acoustic delay lines consisting of highly oriented electroacoustic CdS transducers vacuum deposited on single-crystal sapphire propagating media. Typical electrical characteristics at 2 GHz of these thin-film (approximately one micron) transducers and delay media combination, in both coaxial and strip transmission lines, include delay of 6 microsec, insertion loss less than 40 dB, input VSWR less than 2.0 over a 20-percent bandwidth and operating temperature from -74 to +96C. Acoustic propagation velocity, power handling capabilities, and impedance matching techniques used with these electroacoustic delay lines are also discussed. Author (TAB)

N68-32629 National Lending Library for Science and Technology, Boston Spa, (England).
HIGH Q INDUCTANCE SIMULATOR FOR MICROMINIATURE CIRCUITS
F. Capparelli 7 Feb. 1968 15 p refs Transl. into ENGLISH from *Alta Frequenza* (Italy), v. 36, no. 3, Mar. 1967 p 226–232 *Its* Transl. 2451
Available from Natl. Lending Library, Boston Spa, Engl.

The inductive effects presented by some semiconductor devices are examined, and the possibility of their practical use in integrated circuits is discussed. A simple transistor circuit is proposed which lends itself to the construction of high Q inductances over a wide range of frequencies. The device is easy to microminiaturize and therefore seems to be an effective solution to the problem of inductances for integrated selective circuits. Author

N68-32640# Naval Avionics Facility, Indianapolis, Ind.
THERMOCOMPRESSION BONDING OF GOLD WIRE FOR MICROELECTRONIC CIRCUITS
Thomas E. Higbie 26 Oct. 1967 35 p refs
(NAFI-TR-1108; AD-671879)

The report details a technique for interconnecting master die integrated circuits using thermocompression bonding. Primary coverage is given to specific results achieved and the techniques used. Author (TAB)

N68-32643# Harry Diamond Labs., Washington, D. C.
A NEUTRON-HARDENED INTERMIDIATE FREQUENCY AMPLIFIER
James M. Barnes Apr. 1968 20 p refs
(HDL-TM-68-16; AD-671615)

An IF amplifier capable of surviving in a neutron environment has been designed and evaluated. The design described uses readily available silicon NPN epitaxial planar transistors throughout. The amplifier includes an automatic gain control and video detector, and results are presented which show it to be capable of good performance after exposure to 5 x 10 to the 14th power neutrons/sq cm (E > 10 keV). Author (TAB)

N68-32650 Polytechnic Inst. of Brooklyn, N. Y.
A NEW CLASS OF LOW-LOSS REACTIVE-WALL WAVEGUIDES
Raymond Peter Larsen (Ph.D. Thesis) 1967 250 p
Available from Univ. Microfilms: HC $11.25/MF $3.25 Order No. 67-13,403

A novel approach is presented for achieving waveguides with especially low loss. This new class of waveguides employs "reactive walls," and has possible application to millimeter wave or high power systems. These "reactive walls" are designed by initially choosing them to be periodic structures in the transverse directions, which are operated in their stopband or below cut-off condition. Because the resulting transverse decay rate is high, the periodic structure can be truncated, and a simple, closed, final form results. The type of periodic structure chosen for investigation was an array of parallel dielectric slabs. Both parallel-plate and rectangular waveguide structures incorporating such slabs were analyzed using a transverse resonance procedure together with a systematic graphical method of solution. Dissert. Abstr.

N68-32678 National Lending Library for Science and Technology, Boston Spa (England).
DESIGN OF CONTACT DEVICES WITH A MINIMUM LEVEL OF RADIO INTERFERENCE
Yu. A. Morozov 26 Sep. 1967 13 p refs Transl. into ENGLISH from *Elektrotekhnika* (Moscow), no. 1, 1967 p 49–51 In RUSSIAN and ENGLISH
(EE1643) Available from Natl. Lending Library, Boston Spa, Engl.

Radio frequency interference in alternating current contact devices is analyzed during circuit closure and during contact separation using a proposed electrical device, and experimental relationships between radio interferences and the rate of contact separation are derived. The significance of observations and results in the design of contacts for electrical devices is discussed. S.C.W.

N68-32911# Naval Avionics Facility, Indianapolis, Ind.
STANDARD HARDWARE PROGRAM RAMP GENERATOR MODULE
Leo F. Welsh Apr. 1968 24 p
(NAFI-TR-1209; AD-671852)

The report describes a programmable ramp generator packaged in a Standard Hardware Program Size 1-A module. The slope, amplitude, and DC level of the output are selected by means of either pin programming or remote programming. The initial design was for use in the sensitivity time constant (STC) circuits in airborne radar receivers. Included in this report is an appendix describing this module in a format compatible with SHP specification control drawings. Author (TAB)

N68-32917 National Lending Library for Science and Technology, Boston Spa (England).
LOW NOISE PARAMETRIC NATURAL RESONANCE AMPLIFIERS WITH LARGE BANDWIDTHS
J. Edrich 20 Nov. 1967 18 p refs Transl. into ENGLISH from *Frequenz* (West Berlin), v. 20, no. 10, 1966 p 337–343
(Trans-2437) Available from Natl. Lending Library, Boston Spa, Engl.

Wide bandwidths can be attained by the well-known principle of multi-tuning, and by utilization of the natural diode resonances. A few configurations of such self resonance amplifiers are known, but no detailed investigations exist as far as the attainable bandwidths are concerned. A high diode-Q provides a good noise performance, but it also causes low bandwidths. The calculations of this paper take into account all diode stray reactances show that, the use of high diode-Q's for wideband amplifiers will usually be more favorable. When the idler frequency equals the diode series-resonant frequency, the gain-bandwidth product is about 90% higher than when it equals the parallel-resonant frequency. In the first case a casing capacitance as low as possible is desirable, whereas in the second a finite optimum value exists for this stray capacitance. The theoretical results are discussed and experimentally verified by means of measurements on pushpull amplifiers. Author

N68-32958# Naval Ammunition Depot, Crane, Ind.
INFORMATION ON MICROELECTRONICS FOR NAVY EQUIPMENTS Micro Notes
1 Jul. 1968 222 p *Its* Issue No. 24
(AD-671797)

Contents include: Microelectronics FSK receiver; Evaluation of digital units; Evaluation of analog units; Plastic encapsulated semiconductor devices and microcircuits; Introduction to radiation effects in integrated circuits. TAB

N68-33025# Stanford Univ., Calif. Electronics Labs.
WIDE-BANDWIDTH INTENSITY MODULATION OF A CATHODE-RAY BEAM WITH DC TO 12-GHZ GUN Final Report
H. F. Schmid Oct. 1967 89 p refs
(Contract AF 33(615)-3589)
(SU-SEL-67-093; TR-1968-1; AD-671511)

A new electron-gun structure capable of cathode-ray beam modulation with frequencies from dc to 12 GHz has been developed. The modulating structure consists of a coaxial transmission line with an integral cathode and modulating grid forming part of the center and outer conductors, respectively. The gun can be used with conventional magnetic and electrostatic focusing and deflection systems. The design requirements for the coaxial structure are compatible with those for high resolution. An experimental cathode-ray tube, built with a gun of this design and using a total accelerating potential of 24 kV, produces a visible display of a single pulse of nanosecond duration and an amplitude as low as 1 V at a writing speed of 2 X 10 to the 7th power cm/sec; this display can also be photographed. The dynamic range of beam intensification, corresponding to an increase in spot size from a minimum of 0.004 in. to 0.008 in., is approximately 20 dB for single-shot pulses of nanosecond duration. For repetitive pulses the dynamic range is greater, typically 30 dB. This report describes the design and performance of two cathode-ray tubes with guns of the above construction and also describes the design and operation of the SH1968-B Nanosecond Beam Intensification Display Unit. The SH1968-B is a self-contained display device consisting of the two display tubes and all associated sweep circuits and power supplies. Author (TAB)

N68-33185*# National Aeronautics and Space Administration. Electronics Research Center, Cambridge, Mass.
MICROELECTRONICS IN SPACE
W. Crawford Dunlap *In its* Aerospace Electron. Systems Technol. 1967 p 233-242 (See N68-33169 20-30)

In assessing the high temperature microelectronics problem, which involves reliable operation in excess of 400°C, consideration is being given to a space-charge-limited thin film device, and to an ion implantation process for forming junctions and ohmic contacts on materials for which diffusion and other techniques are inapplicable. Some of the approaches being taken to the high reliability problem are cited as a laboratory pilot plant for investigating silicon microcircuit process improvements and failure mechanisms, thin film processing techniques, computer-aided circuit design, and superconducting electronics. It is also reported that microcircuit standards are being set up, a data bank is being established, and qualifications for circuits and vendors for NASA procurements are being defined. M.G.J.

N68-33204 European Organization for Nuclear Research, Geneva (Switzerland).
A NON-LINEAR STEP-PULSE STEEPENING DELAY LINE
A. Brueckner 12 Jul. 1968 15 p
(CERN-68-25)

A new way of producing a fast rise-time of a step-pulse is studied. This will be applied to the kicker system between the booster and the proton synchrotron, (ps) where magnetic field rise-times of the order of 45 nsec are required. For PS injection, this steepening time will be used as the tail-clipper and will produce a fast fall-time. The idea is to use a lumped delay-line with linear capacitors and nonlinear (saturating) inductors. This type of non-linear delay-line varies its propagation time and its wave impedance according to the wave voltage. It is able to steepen the rise of a step function produced, for example, by a thyratron. The ultimate rise-time that can be reached depends on the ferrites that are used, on the geometry of the capacitors, and on all stray inductances. These must be kept as small as possible. The best experimental results for rise-times are: 7 nsec for a 25 Ω line at 30 kV and 3 nsec for a 25 Ω line at 3kV. Author

N68-33224*# Hartman-Huyck Systems Co., Huntington Station, N. Y.
A CATHODE RAY TUBE SUITABLE FOR VIEWING UNDER HIGH AMBIENT
Donald Amberger Washington NASA Sep. 1968 84 p refs
(Contract NAS12-97)
(NASA-CR-1185) CFSTI: HC $3.00/MF $0.65 CSCL 09A

A high contrast cathode ray tube, employing nonreciprocal optical filtering techniques was developed. The non-reciprocal filter design consists of a UV bandpass filter, a fluorescent film and a visible bandpass filter. All elements are transparent. The filter is between the observer and an ultra-violet emitting cathodoluminescent phosphor. Incident light strikes the visible filter and is partially absorbed. The remaining ambient passes through the transparent fluorescent film and is absorbed by the UV filter. The two filter layers have no mutual bandpass. Return diffuse reflection or emission from the fluorescent film and any return reflection from the phosphor are therefore eliminated. Attention is focused on the problem of eliminating diffuse reflection. Author

N68-33235*# Westinghouse Electric Corp., Youngwood, Pa. Semiconductor Div.
DESIGN AND DEVELOPMENT OF A HIGH POWER, LOW SATURATION VOLTAGE SILICON SWITCHING TRANSISTOR
Ernest R. Stonebraker Jul. 1968 14 p ref Prepared for JPL
(Contracts NAS7-100; JPL-952043)
(NASA-CR-96287; QR-3) CFSTI: HC $3.00/MF $0.65 CSCL 09A

Theoretical considerations indicated the feasibility of developing a transistor with a saturation voltage of 0.1 volt at 75 amperes collector current. This was to be accomplished by making emitter and collector junctions as nearly symmetrical as possible in order to equalize the junction voltages. Practical experience has indicated that technical difficulties with the original approaches resulted in low gain and/or voltage. Since some of these technical difficulties can be circumvented by the use of the epitaxial base process, it was decided that this approach should be used for the remainder of the project. Author

N68-33329*# Texas Instruments Inc., Dallas.
STUDY OF SOLID-STATE INTEGRATED MICROWAVE CIRCUITS Scientific Report, 13 Mar.-16 Jun. 1967
30 Jun. 1967 190 p refs
(Contract NAS12-75)
(NASA-CR-96449; U26-811500-26; SR-4) CFSTI: HC $3.00/MF $0.65 CSCL 09A

Microwave components, devices, and integrated techniques applicable to a low-noise, solid-state receiver in the 1- to 6-GHz frequency range are presented in this report. Data are also given on devices such as the field effect transistor and linear integrated circuits with frequency responses extending to the VHF region. The report relates the microwave properties of ferrites, dielectrics, thin film, and microstrip as used in filters, isolators, and circulators. The characteristics of Schottky barrier, varactor, avalanche, and tunnel diodes are discussed as well as the power application and low-noise behavior of different transistor geometries. Author

N68-33377# Sigmatron, Inc., Goleta, Calif.
DEVELOPMENT OF PHOTORESISTIVE ELEMENTS FOR AN ANALOG MULTIPLIER Final Report, 1 Feb.–31 Jul. 1967
David M. Heinz, Henry J. Hebert, and Winston N. Sharp Dec. 1967 46 p refs
(Contract F33615-67-C-1468)
(AMRL-TR-67-168; Rept.-2010; AD-671980)

Cadmium sulfide layer photoresistive cells having improved properties and improved cell-to-cell uniformity have been developed for use in an analog multiplier. Each program objective -- a temperature coefficient below 0.1 percent per C deg., a voltage effect coefficient below 0.02 percent per volt, and a response time of less than 10 msec. -- has been realized in an individual photocell but all of these characteristics have not been embodied in a single photocell. The fabrication techniques employed on this program, including vacuum deposition, heat treatment, electroding and encapsulation are described. Measurement techniques for evaluating temperature effect, voltage effect, response time, and long-term stability are presented. Author (TAB)

N68-33466 Minnesota Univ., Minneapolis.
NOISE IN SOLID STATE DEVICES
Sie Tung Liu (Ph.D. Thesis) 1967 99 p
Available from Univ. Microfilms: HC $5.00/MF $3.00 Order No. 67-14630

This thesis gives experimental studies on noise in metal-metal oxide-metal diodes and single injection space-charge-limited diodes. Tunneling of electrons can occur at a metal-insulator interface, when a high electric field is present within the insulator. This phenomenon was studied with reference to a thin film diode structure consisting of two metal layers separated by a thin insulating metal oxide layer. It is shown experimentally that the noise caused by electrons tunneling through a very thin insulating layer in the thin film diodes is shot noise. This can be seen by considering the passage of electrons through the insulating layer as a series of independent events occurring at random, because the tunneling probability is very small. Thus the fluctuating electrons follow a Poisson distribution. Dissert. Abstr.

N68-33524*# Scientific-Atlanta, Inc., Atlanta, Ga.
LATCHING FERRITE SWITCH Final Report, May 1967–Jun. 1968
Jun. 1968 62 p refs
(Contract NAS5-10422)
(NASA-CR-96380) CFSTI: HC $3.00/MF $0.65 CSCL 09A

A ferrite latching switch and combiner were constructed with circulators having a typical insertion loss of 0.2 dB and an isolation exceeding 20 dB. Rigid coax was used to interconnect the 33 latching circulators because the device was in prototype form and no effort was made to integrate the microwave components. Total switch insertion loss was about 2.5 dB, of which half of this was directly contributed by the cable. The switch itself gave excellent isolation between undesired channels and worked well over temperatures between −20 and 125°F. M.W.R.

N68-33585 National Lending Library for Science and Technology, Boston Spa (England).
SINTERED MATERIALS AND PARTS FOR ELECTRICAL ENGINEERING AND INSTRUMENTS
A. B. Al'tman 29 Jul. 1968 22 p refs Transl. into ENGLISH from Poroshkovaya Met. (Ukranine), v. 7, no. 11, 1967 p 85–74 *Its* Transl. No. 68/133
Available from Natl. Lending Library, Boston Spa, Engl.

A variety of powder material applications in electro-engineering techniques are depicted. Composite and as-pressed powder electric materials are used in the manufacture of electrical machines, apparatus, and instruments. Metal powders find application in semi-finished products and parts characteristic for magnetic, contact, resistance, conducting, and semiconducting media. G.G.

10 ELECTRONICS

Includes circuit theory; and feedback and control theory. For applications see: 09 Electronic Equipment. For related information see: Specific Physics Categories.

N68-32255 Case Inst. of Tech., Cleveland, Ohio.
MULTILEVEL SYSTEMS AND UNCERTAINTIES
Yasuhiko Takahara (Ph.D. Thesis) 1967 270 p
Available from Univ. Microfilms: HC $12.15/MF $3.50 Order No. 67-16105

A multilevel system theory and, particularly, the on-line coordination problem are discussed. The thesis consists of three parts. In the first part the intuitive concepts of the multilevel system theory are generalized and formulated mathematically. In the second part investigation is made of the online coordination of a multilevel system within the framework developed in the first part. Some properties of the decision-making under true uncertainty which are indispensable in the consideration of the on-line coordination problem of a multilevel system are discussed in the last part. Dissert. Abstr.

N68-32415 Texas Univ., Austin.
ANALYSIS OF DISTRIBUTED AMPLIFIER STRUCTURES
Randolph Clair Matson (Ph.D. Thesis) 1967 84 p
Available from Univ. Microfilms: HC $4.40/MF $3.00 Order No. 67-14863

This research includes an analysis of the stability requirements and an evaluation of feasible configurations for linear solid-state distributed amplifiers. In particular, the structures considered may have one or more negative parameters. The models investigated are divided into reciprocal and nonreciprocal types. The study concludes with an investigation of semiconductor material properties that will increase the upper frequency cutoff and negative region voltage swing. The materials considered are gallium arsenide, indium arsenide, indium antimonide, silicon, and germanium. For a compromise, gallium arsenide is the most advantageous, followed by germanium. Recommended ferrite materials, semiconductor doping levels, diode and ferrite dimensions are determined for gallium arsenide and germanium. Dissert. Abstr.

N68-32686 National Lending Library for Science and Technology, Boston Spa (England).
ELEMENTS OF CALCULATION IN AUTOMATIC CONTROL SYSTEMS
V. V. Volgin, ed., N. P. Buvin, M. A. Pan'ko, V. Ya. Rotsch, and M. A. Seleznev Feb. 1968 86 p refs Transl. into ENGLISH of the book "Elem. Rascheta Sis. Avtom. Reg." Moscow, 1963 p 2–124
(RTS-4264) Available from Natl. Lending Library, Boston Spa, Engl.: 40s

Reported is a textbook containing supplementary material for a course on automatic control which was designed for students specializing in the automation of production processes. Described are methods for determining transfer functions and frequency responses from step response curves, and graphical analytical methods for plotting transient processes in automatic control systems. S.C.W.

N68-32751# Purdue Univ., Lafayette, Ind. School of Electrical Engineering.
ON THE APPLICATION OF THE POTENTIAL FUNCTION METHOD TO PATTERN RECOGNITION AND SYSTEM IDENTIFICATION

R. R. Lemke Apr. 1968 180 p refs
(Contracts N00014-67-A-0226; NSG GK-1970)
(TR-EE68-8; AD-671991)

The theoretical foundations of the potential function method are presented quite thoroughly in the pattern recognition literature. However, many problems are encountered when applying the potential function method to practical problems. Some of these problems are: (1) How are the potential functions formed; (2) What are the computational restrictions; (3) What a priori information is necessary or desirable. The potential function method is discussed in considerable detail to show how the two types of potential functions differ. The memory requirements of two forms (types) of the potential functions are discussed when applied to pattern classification. Application of the potential function method to system identification is accomplished by converting the system identification problem to a pattern recognition problem. Author (TAB)

N68-32937# State Univ. of New York at Buffalo. Digital Systems Lab.
THE DESIGN OF MULTIPLE-VALUED LOGIC SYSTEMS Final Report, 1 Jun. 1967–31 May 1968
Donald D. Givone and Robert W. Snelsire Jun. 1968 114 p refs Sponsored by ONR
(AD-671877)

A multiple-valued algebra is introduced as a mathematical model for the study of switching circuits having two or more logic values. A minimization criterion is given and various minimization techniques for manipulating functions expressed in this algebra. In particular, an algorithmic method is presented for deriving all minimal cost representations of the switching functions. Author (TAB)

N68-32962 National Lending Library for Science and Technology, Boston Spa (England).
DIGITAL CONTROL EQUIPMENT FOR IMPULSE-CONTROLLED THRUST PISTON MOTORS AND ROTARY MOTORS [DIGITALE STEUEREINRICHTUNG FUER IMPULSGESTEUERTE SCHUBKOLBEN- UND ROTATIONSMOTOREN]
Mathias Ott 13 Sep. 1967 19 p Transl. into ENGLISH from Oelhydraulik und Pneumatik, v. 11, no. 1, 1967 p 7–11 In ENGLISH and GERMAN
(NEL-TT-1906) Available from Natl. Lending Library, Boston Spa, Engl.

The advantages, disadvantages, and operating characteristics of digital control equipment for thrust piston motors and rotary motors are briefly discussed. A digital control system is described wherein only one impulse valve and one change-over switch are applied to conventional rotary or piston servo-motors. The system is based on the idea that an impulse valve imparts alternating pressure and quantity impulses into inlet and outlet ports. There are always two valves for each port that lead to the displacement chambers. The opening of the inlet and outlet ports are governed by the movement of the rotor in alternating sequences. Design schematics are given to show how a pulse unit is to be applied to conventional thrust and rotary piston motors. B.S.D.

N68-32980# Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Angewandte Reaktorphysik.
AUTOMATIC CONTROL SYSTEM FOR BALANCED OSCILLATOR TESTS
M. Audoux, L. Caldarola, P. Giordano, and H. Rohrbacher Sep. 1967 40 p refs Sponsored by US-EURATOM
(EURFNR-498; KFK-667; EUR-3700e)

It has been demonstrated that the Balanced Oscillator Tests are more convenient than the traditional oscillator tests. They provide accumulation of more complete and precise information on reactor parameters such as reactivity coefficients, fuel time constant, etc. A special automatic control system to carry out these experiments has been developed, built and tested on the analog computer. This type of automatic control system will perform Balanced Oscillator Tests on SEFOR (Southwest Experimental Fast Oxide Reactor). Author (NSA)

N68-33127# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
A CONTROL SYSTEM WITH DUPLICATING ACTUATING ELEMENTS [SISTEMA UPRAVLENIYAS DUBLIRUYUSHCHIMI ISPOLNITEL'NYMI ORGANAMI]
I. T. Borisenok *In its* Moscow Univ. Herald. Ser. 1: Math., Mech., No. 2, 1964 6 Jun. 1967 p 99–114 refs (See N68-33115 20-19)

The author investigates oscillations and the conditions under which they arise in control systems with properly operating and faulty redundant elements. He considers the cases where the characteristics of the redundant elements are linear and nonlinear. Under certain conditions on the coefficients, a linear control system with properly operating redundant elements may attain periodic motion, and the motion of the elements of control becomes synchronous in the course of time. If the rudder is deviated to the opposite side, the oscillation amplitude increases. A nonlinear control system with properly operating redundant elements may have periodic motion under a certain condition, and the small values of the zone of insensitivity of the characteristics of the redundant elements have little effect on the size of instability of the amplitude of the steady-state oscillations. The region of stability of a control system with defective redundant elements decreases in comparison to the region of stability of a control system with properly operating elements. The introduction of control by a derivative with the help of a transmitter of angular velocities of a differentiating correcting contour of prediction makes it possible to decrease considerably the amplitude of steady-state oscillations in a nonlinear control system. Author

N68-33163*# Texas Univ., Austin. Communications Systems Research Group.
OPTIMAL ADAPTIVE FILTER REALIZATIONS FOR SAMPLED STOCHASTIC PROCESSES WITH AN UNKNOWN PARAMETER
C. G. Hilborn, Jr. and D. G. Lainiotis Jul. 1967 18 p refs
(Grants NGR-44-012-066; AF-AFOSR-766-66)
(NASA-CR-96374; CSRG-TR-67-3) CFSTI: $3.00 CSCL 09C

Techniques are derived for realizing Bayes optimal learning systems in analog delay-feedback form for filtering a sampled stochastic process in the presence of an unknown or random parameter when the optimal filter for known parameter value can be realized. The unknown parameter may take on a bounded but continuous range of real values, and be either an unknown and random constant or a Markov random process. Examples of the techniques are given for both constant and time-varying parameters. Author

N68-33305 Pennsylvania Univ., Philadelphia.
CONTRIBUTIONS TO THE THEORY OF LEARNING AUTOMATA
Balakrishnan Chandrasekaran (Ph.D. Thesis) 1967 154 p Available from Univ. Microfilms: HC $7.20/MF $3.00 Order No. 67-12735

A class of learning stochastic automata can be defined by the sextuple $[S, \Phi, F, g, \vec{x}, T]$ where S is the input set, Φ is the finite set of r states, F is the finite set of r outputs or 'actions' of the automaton, g is the output function which is a one-to-one mapping between the states and the outputs, and $\vec{x}$ is the state probability vector whose ith component is the probability of the ith state being chosen. T is the reinforcement operator which gives the automaton its learning property. Action f_i may correspond to

the ith region of the quantized control variable in a random searching scheme, the ith strategy in a game situation etc. The automaton output acts on the environment which is defined by the penalties with which it responds to the automaton actions.
Dissert. Abstr.

N68-33469# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
A LOGIC MACHINE FOR AUTOMATIC SYNTHESIS OF (1, K)-TERMINAL SWITCHING NETWORKS [LOGICHESKAYA MASHINA DLYA AVTOMATICHESKOGO SINTEZA KONTAKTNYKH (1, K)-POLYUSNIKOV]
V. R. Gorovoy, V. M. Kucherov, P. P. Parkhomenko, and Yu. L. Tomfel'd 7 Dec. 1967 15 p refs Transl. into ENGLISH from Akad. Nauk SSSR, Avtomat. i Telemekh. (Tekhn. Kibernetiki) (Moscow), 1968 p 269-276
(FTD-MT-24-318-67; AD-671648)

A special-purpose machine (Parus-1) is described which is intended for automatic synthesis of (1, k)-terminal switching networks by combinational logic. The automaton is capable of synthesizing (1, 4)-terminal networks using 6 variables, (1, 8)-terminal networks with 5 variables, and (1, 12)-terminal networks with 4 or fewer variables. The synthesized network may contain a maximum of 14 nodes with at most 10 switching elements connected between any two nodes. Input data (logical requirements) in the form of a truth table are introduced through 16 groups of 3-position switches (16 switches per group). The three positions correspond to the 0, 1, and dont-care outputs of the synthesized network. Results are displayed on a board containing signal lights each of which represents one contact between two nodes. It was established that of the synthesized networks 60% contained the same number of contacts as the reference structures, 3% had fewer contacts, and 37% had more contacts. The number of redundant contacts usually did not exceed one.
TAB

N68-33509# Joint Publications Research Service, Washington, D. C.
SOME QUESTIONS IN THE OPTIMIZATION OF A LARGE PROJECT CONTROL SYSTEM WITH HIERARCHIC STRUCTURE
A. I. Chukhnov 27 Aug. 1968 32 p refs Transl. into ENGLISH from Ekon. i Mat. Metody (Moscow), v. 4, no. 3, May-Jun. 1968 p 384-400
(JPRS-46288) CFSTI: HC $3.00/MF $0.65

Basic trends in relation to the analysis and synthesis of dynamic production control systems considered are the use of well-developed methods of automatic control theory and the approach to production control systems as large control systems with hierarchic structures. Analysis of the dynamic qualities and optimization of such systems is discussed from a technical management point of view, assuming that individual subsystems can be described as stationary linear one-dimensional automatic control systems. The optimization criterion is the minimum cumulative integrated square subsystem error subject to controlling resource restrictions. Optimization of aggregated systems described by quadratic functionals is detailed, and the physically realizable optimum controllers of project subsystems are synthesized. Attention is given to the case where system input is acted on by the useful signals and noise.
M.W.R.

N68-33554* Santa Clara Univ., Calif. Dept. of Electrical Engineering.
STABILITY AND SENSITIVITY
Dragoslav Siljak [1968] 14 p refs Presented at 2nd IFAC Symp. on System Sensitivity and Adaptivity, Dubrovnik, Yugoslavia, Aug. 1968
(Grant NGR-05-017-010)
(NASA-CR-96360) CFSTI: $3.00 CSCL 09C

This paper extends the notion of absolute stability to include the parameter variations of the linear part of the system. Both graphical and analytical techniques are proposed to calculate the regions of absolute stability in the parameter space. The graphical technique is based upon the construction of an envelope of the stability region. In the analytic procedure, a parallelepiped of maximum volume is imbedded in the region to interpret readily its boundaries and obtain useful information about parameter variations which do not affect the system stability.
Author

N68-33578*# Massachusetts Inst. of Tech., Cambridge. Dept. of Electrical Engineering.
DESIGN OF WAVEGUIDES AND TRANSMISSION LINES BY THE DISTRIBUTED MAXIMUM PRINCIPLE
Jerry Burchfiel and Michael Athens [1968] 8 p refs Submitted for publication
(Grant NGL-22-009-124)
(NASA-CR-98358) CFSTI: HC $3.00/MF $0.65 CSCL 09C

This paper deals with the optimal design of transmission lines with waveguides so as to minimize the reflected power due to mismatch over a frequency band. The problem is formulated on a distributed parameter control problem, and the maximum principle for distributed parameter systems is used to derive the optimal capacitance (permittivity) per unit length; this is evaluated by an algorithm which solves the resultant two point boundary value problem. Numerical results are presented for a waveguide example.
Author

11 FACILITIES, RESEARCH AND SUPPORT

Includes airports; lunar and planetary bases including associated vehicles; ground support systems; related logistics; simulators; test facilities (e.g., rocket engine test stands, shock tubes, and wind tunnels); test ranges; and tracking stations.

N68-32428# Federal Aviation Administration, Atlantic City, N. J. National Aviation Facilities Experimental Center.
FLOW CONTROL: AN INVESTIGATION OF A TECHNIQUE FOR PREDICTING DEMAND AND SERVICE AT THE TERMINAL FACILITY Final Report
Gordon D. Jolitz Aug. 1968 46 p refs
(NA-68-20; RD-68-44)

The concept of the flow control function as a part of the Air Traffic Control (ATC) system includes a requirement for information about the volume of air traffic demand on the ATC system relative to the system's capacity for servicing such a demand. The demand prediction process described in this report was based on two related hypotheses: (a) air traffic demand on an airport is repetitive in nature such that historical operations data would be useful as a predictor; and (b) operations information known to the Air Traffic Control (ATC) system would be a useful predictor. A computer program was developed which permitted joint use of the two predictors and, using sample data from a test case (Washington National) airport, the prediction model was evaluated. A companion program which was designed to provide service predictions took into account such environmental factors as weather and runway configuration. The criterion against which the model's predictions were tested was a count of actual operations. It was concluded that demand predictions were not highly correlated with the criterion and that errors in prediction appeared to be normally distributed and random with time.
Author

N68-32487*# Columbia Univ., New York. Electronics Research Labs.
THE FLUID TRANSPIRATION ARC AS A RADIATION SOURCE FOR SOLAR SIMULATION Semiannual Progress Report, Jul. 1-Dec. 31, 1967

C. Sheer and S. Korman 1 Mar. 1968 27 p refs Sponsored in part by NASA
(Contract AF 49(638)-1395)
(NASA-CR-96237; P-4/312; AFOSR-68-0762; AD-669841)
CFSTI: HC $3.00/MF $0.65 CSCL 14B

The report is one in a series of progress reports on a project to develop the fluid transpiration arc as a radiation source for solar simulation. Continuing with the colinear opposing flow geometry of the two electrode columns, a complete module has been designed, constructed, assembled and instrumented for operation and for analysis of radiation and energy dissipation. Work was also begun on assembly of spectral irradiance instrumentation. Preliminary testing disclosed two basic problems, requiring effort directed toward auxiliary development. These problems were (1) maintenance of the integrity and porosity of the tungsten porous anodes, specifically to avoid destruction or deterioration of the surface by melting; (2) the need for a porous tungsten anode design which would ensure that all of the gas metered to the anode would enter the arc discharge--a requirement which was particularly acute at pressures above atmospheric. Both problems were successfully solved and the results incorporated into the program.
Author (TAB)

N68-32505# Atomic Energy of Canada, Ltd., Chalk River (Ontario). Nuclear Labs.
PHYSICS DIVISION PROGRESS REPORT, APRIL 1 TO JUNE 30, 1968
30 Jun. 1968 90 p refs
(AECL-3157; PR-P-78) Available from Atomic Energy of Can., Ltd., Chalk River: $2.00

Experiments with an improved MP tandem beam-transport system continued on Coulomb excitations of $^{24}M_g$ by ^{35}Cl and ^{4}He ions and of ^{35}Cl projectiles with both ^{24}Mg and ^{12}C targets. Lifetime measurements in ^{35}Cl using the $^{32}S(\alpha,p)$ reaction have been completed and triple angular correlations of gamma rays from the reaction $^{31}P(\alpha,p)$ ^{34}S were measured. Solid state studies centered on magnetic excitations in antiferromagnetic $KMnF_3$ by neutron scattering at low temperatures and a theoretical study of scattering from macroscopic systems. Germanium lithium-drifted coaxial diodes exhibited good trapping effects up to 2000V applied bias in the conventional detector but showed poor performance with 1000V applied to the second detector. Computer programs were written to search spectra for peaks, to retrieve data from cross-section data files, and to carry out a variety of operations on these data.
G.G.

N68-32605# Bowles Engineering Corp., Silver Spring, Md.
JET DELIVERY OPTIMIZATION Final Report
Apr. 1968 119 p refs Sponsored by Dept. of Transportation
(R-4-23-68; PB-178437)

The report investigates several approaches to improve water jet delivery toward the end of improving the efficiency of hydraulic tunneling and mining. These approaches are directed toward the reduction of water jet velocity decay by suppressing pressure disturbancees and turbulence which cause jet breakup, by such means as the use of turbulence suppressing chemical additives, the design of a minimum transverse turbulence nozzle, and the suppression of air shear on a free water jet by providing the jet with a moving air cheath. In addition, an investigation is made of the use of a Fluidic Jet Modulator to generate liquid slugs which would produce high pressure impulsive shocks when impacting upon a rock face. A survey is made of the various modes of rock fracture in order to relate the results of the investigation to the problems of tunneling or mining. An evaluation is made of each of the separate studies as to its applicability to tunneling and its technical and economic feasibility. Finally, a system is proposed which incorporates the most effective results of the investigation.
Author (USGRDR)

N68-32616# Bowles Engineering Corp., Silver Spring, Md.
HYPERVELOCITY JET DRIVER STUDY Final Report
V. Neradka, W. Walston, and R. Turek May 1968 87 p refs Sponsored by Dept. of Transportation
(R-4-22-68; PB-178506)

This study investigates analytically a concept for accelerating liquid slugs to high velocities by the use of supersonic gas nozzles. This technique is of interest for developing economic methods for cutting rock during tunnel construction. The merits of this concept are based on the fact that only moderate gas pressures are required to accelerate liquid slugs to velocities which have been demonstrated as suitable for fracturing rock material. To obtain these velocities by liquid nozzles alone, very high hydraulic pressures would be required. This concept, therefore, amplifies the pressure which is used to accelerate the slug to a high value delivered to the face of the rock material. The concept for mechanizing this augmentation is a hypervelocity gun comprising of a constant area section tube for accelerating the slug to sonic speed and a diverging area tube for further accelerating the slug to supersonic gas speeds. Analyses are performed to evaluate the lengths and acceleration times for both sections of the gun under different conditions of supply pressure and temperature and slug sizes. An important aspect of this concept is the requirement to control the hypervelocity jet driver repetitively at a controlled frequency and slug size. The design considerations for such a jet driver control system are considered and a preliminary concept is presented.
Author (USGRDR)

N68-32809 European Organization for Nuclear Research, Geneva (Switzerland).
A WIRE SPARK CHAMBER PULSING SYSTEM WITH FOUR THYRATRONS
G. Lennart Andersson 12 Jul. 1968 20 p refs
(CERN-68-26)

In order to generate HV pulses for wire spark chambers with magnetic core read out, a system with four hydrogen thyratrons of the tetrode type has been developed and built. It gives negative pulses with a maximum amplitude of 5 kV and nominally 170 nsec length into eight 8 Ω loads. The rise time of the pulse is typically of the order of 20 nsec, and the total delay, measured from the trigger pulse input, is 85 nsec. Power consumption and dissipation limits the pulse repetition frequency to 1 kHz at 10% duty cycle.
Author

N68-32952# General Electric Co., St. Petersburg, Fla. Neutron Devices Dept.
TECHNIQUE FOR STUDYING ION BEAMS OF OPERATING NEUTRON TUBES
R. D. M. Peters 13 May 1968 4 p
(Contract AT(29-2)-656)
(R-68-ND-11; Gepp-34) CFSTI: HC $3.00/MF $0.65

Previous ion beam focusing studies in neutron tubes relied primarily on photographs of phosphor targets or autoradiographs to determine beam configuration. A new technique for studying ion beams of operating neutron tubes is described. This technique may be used: (1) to study tubes that have been baked out to less than 400°C, (2) to produce neutrons, and (3) to provide unique information on the configuration of the ion beam for each shot.
Author (NSA)

N68-33024*# Techtran Corp., Glen Burnie, Md.
A STUDY ON A MAXIMUM-SPEED WIND TUNNEL FOR RE-ENTRY INVESTIGATIONS [STUDIE UBER EINE HOCHSTGESCHWINDIG-VERSUCHSANLAGE FUR WIEDEREINTRITTSUNTERSUCHUNGEN]
P. Nitsch, E. Riester, and N. Schmidt Washington NASA Aug. 1968 23 p Transl. into ENGLISH from DFL-67-11 Rept.
(Contract NASw-21061)
(NASA-TT-F-11886) CFSTI: HC $3.00/MF $0.65 CSCL 14B

The layout of a maximum-speed wind tunnel for reentry conditions with sufficient running time and rather good simulation of real gas effects is studied. Test results concerning parts of the test facility are given. The installation of the test plant could be made most economical by using the hot-water supply of the DFL at Trauen as energy source for producing electric power and for the suction side of the tunnel drive. Author

N68-33030# Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.
CONTAINMENT SYSTEMS EXPERIMENT
J. M. Batch, G. J. Rogers, and R. K. Hilliard 14 May 1968 38 p Presented at 2d Am. Inst. of Chem. Engr. Meeting, Tampa, 19–22 May 1968
(Contract AT(45-1)-1830)
(BNWL-SA-1863; Conf-680514-1) CFSTI: HC $3.00/MF $0.65

Description of the Containment Systems Experiment (CSE) is presented. Experimental facilities are described and test descriptions are included. Results of the experimental program are presented. NSA

N68-33129*# Ilikon Corp., Natick, Mass.
DEVELOPMENT, CONSTRUCTION AND TESTING OF AN ULTRAHIGH VACUUM dc SPUTTERING SYSTEM Final Report
George Horn and Paul Gould Jul. 1968 25 p
(Contract NAS12-546)
(NASA-CR-86092) CFSTI: HC $3.00/MF $0.65 CSCL 14B

An ultrahigh vacuum system was developed to create state of the art environment for a pair of direct current sputtering electrodes. Two diffusion pumps in series were to provide the pumping speed with mechanical roughing pump backing. To eliminate contaminant back diffusion, the roughing pump had an in-line electrostatic trap while the two diffusion pumps each had in-line liquid nitrogen traps. The main diffusion pump was fitted with an optically dense freon 12 cooled baffle. The low leakage rate of the system was assured by using all metal gasket seals. The above vacuum system providing the background, the high voltage sputtering electrodes had to be designed such that they would not themselves degrade the environment. They were ceramic, pure silver braze, and stainless steel 316L construction. The anode heatable to 800°C while the cathode was water cooled. The anode was adjustable to provide for gap variations, leveling, and tilt for X-ray studies on the film. Author

N68-33135# Brookhaven National Lab., Upton, N. Y.
RECENT PROGRESS IN LINAC PRE-ACCELERATORS
Th. J. M. Sluyters [1968] 12 p refs Sponsored by AEC
(BNL-12494; Conf-680515-1) CFSTI: HC $3.00/MF $0.65

Developments in preinjectors, concentrated on beam currents below 200 mA, with the object to pre-accelerate, transport, and bunch beams without dilution and to match them to the longitudinal and transverse phase spaces of the linear accelerator, are discussed. Ion source developments, results obtained with low and high gradient acceleration without significant apparent dilution up to 750 keV with and without prefocusing, and the low energy beam transport system between the accelerator and the linac are examined. NSA

N68-33190*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
DESCRIPTION AND OPERATING PARAMETERS OF A MACH 2 NOZZLE SYSTEM FOR THE LANGLEY 11-INCH CERAMIC-HEATED TUNNEL
Kenneth Sutton Washington Sep. 1968 69 p refs
(NASA-TN-D-4750) CFSTI: HC $3.00/MF $0.65 CSCL 14B

A Mach 2 nozzle system has been developed to operate interchangeably with existing Mach 4 and Mach 8 systems previously available for high-temperature materials research tests with air were made to determine the operating parameters and to define the test environment. Of particular concern were the definition of stream total temperature decay with time and the damage to test specimens due to stream contamination. The diameters of the calibration models and probes were approximately three-fourths of the diameter of the nozzle exit. Results show that the Mach 2 system has a linear decrease of total temperature of approximately 200°R (110°K) in a test time of 600 seconds for the standard operating range of chamber pressure of 115 to 165 psia (0.79 to 1.14 MN/m2). The total temperature range as measured was 2100°R to 4000°R (1170°K to 2220°K). The damage to a test model due to stream contamination from the ceramic bed can be neglected for a significant number of experimental materials. Also, the comparison in pressure, heating-rate, and shear distributions indicates the suitability of material response tests at the stagnation region of a model. The results demonstrate the applicability of the Mach 2 system for an experimental program. Author

N68-33312# Air Force Missile Development Center, Holloman AFB, N. Mex.
TEST RESULTS OF RAIL TOP PLASTIC TRAYS AS A MEANS OF PROGRAMMED WATER BRAKING FOR MONORAIL ROCKET SLEDS
John E. Krauss Jun. 1968 23 p ref
(MDC-TR-68-59; AD-671505)

Tests were conducted to determine the feasibility and practicability of using water-filled frangible rail-top trays to brake monorail track vehicles. This braking technique has been tested at entrance velocities of up to approximately fifteen hundred feet per second with predictable and effective results. Author (TAB)

12 FLUID MECHANICS

Includes boundary-layer flow; compressible flow; gas dynamics; hydrodynamics; and turbulence. For related information see also: 01 Aerodynamics; and 33 Thermodynamics and Combustion.

N68-32234 National Lending Library for Science and Technology, Boston Spa (England).
NEW PROPERTIES OF LIQUIDS [NOVI VLASTIVOSTI RIDIN]
B. V. Deryagin Jan. 1968 23 p refs Transl. into ENGLISH from Ukr. Fiz. Zh. (Kiev), v. 12, no. 4, 1967 p 684–675 Presented at the 7th Conf. on Liquid State Phys., Kiev, 1965
(RTS-4292) Available from Natl. Lending Library, Boston Spa, Engl.: 30s

Bulk shear elasticity of liquids studied by the resonance method indicates the existence of slow relaxation processes in the case of sufficiently small deformations in liquids. Modifications were obtained for a number of polar liquids, for which elasticities lower than those previously reported were measured. Shear modulus was measured by using piezoelectric quartz resonators of X-5° cut and shaped like a rod of rectangular cross-section. Expressions are given for the maximum values of the energies of a vibrating system in the presence of a coupling between the quartz and solid-face plate, and interference methods for determining the thickness of films are presented. Liquids studied included acetone, acetic acid, alcohols, benzene, carbon tetrachloride, oleic acid, vaseline oil and castor oil, and water. M.W.R.

N68-32269 Colorado Univ., Boulder.
AN EXPERIMENTAL AND ANALYTICAL INVESTIGATION OF THE REFLECTION PROCESS OF A DETONATION WAVE

Jerry Dean Droppleman (Ph.D. Thesis) 1967 78 p
Available from Univ. Microfilms: HC $4.20/MF $3.00 Order No. 67-15038

An experimental investigation of the reflection process of a detonation wave was made using a modified Baganoff pressure gauge with a rise time of 0.05 microseconds. Three different mixtures of hydrogen and oxygen with compositions $H_2 + O_2$, $2H_2 + O_2$ and $3H_2 + O_2$ were used as test gases at initial pressure varying from 200 to 600 mm. of Hg. It was found that a peak reflected pressure existed, followed by a lower equilibrium pressure. Chapman–Jouguet calculations were made based upon the assumption that the reflected wave is a detonation wave whose initial conditions are those of the von Neumann spike of the initial detonation wave. These calculations fit the experimental data for the peak pressure within ±10%. Calculations based upon the reaction times of both the initial and reflected waves demonstrate that the reaction time for the incident wave lies between .12 μs and .4 μs while that for the reflected wave is in the range .005 μs to .02 μs. Dissert. Abstr.

N68-32278 Polytechnic Inst. of Brooklyn, N. Y.
HYPERSONIC VISCOUS FLOW OVER SLENDER BODIES HAVING SHARP LEADING EDGES
Stanley Rudman (Ph.D. Thesis) 1967 87 p
Available from Univ. Microfilms: HC $4.60/MF $3.00 Order No. 67-13416

At large values of the hypersonic interaction parameter, the strong interaction description of the flow field fails as boundary layer and shock wave merge. Strong interaction theory requires the ratio of mass flow in the boundary layer to total mass flow in the shock layer to be small. This ratio, proportional to γ_∞/M_∞^2, becomes order one as the leading edge is approached, and so predicts the onset of the merging. Due to the merged nature of the flow the standard method of dividing the flow field into a thin shock, inviscid core, and boundary layer fails to be applicable. This analysis simplifies the Navier–Stokes equations and derives one set of equations valid throughout the flow. The error is uniformly the order of the largest of (1) $(\delta/\mathcal{L})^2$, (2) $T_{max}/M_\infty^2\gamma$, or (3) curvature effects. Significantly, the pressure gradient terms do not appear in the tangential momentum equation. The equations govern the entire flow field; shock structure and shock jump conditions more general than Rankine–Hugoniot can be predicted, which properly account for the effects of shock thickness, wall presence and diffusive transports to the wave. Dissert. Abstr.

N68-32295 British Hydromechanics Research Association, Cranfield (England).
AVOIDANCE OF CAVITATION EROSION IN TURBOMACHINES
J. M. Hobbs 1967 15 p refs 9th Members Conf., Cranfield, Sep. 1967
(SP-931)

Satisfactory hydraulic performance of turbomachines is no guarantee of freedom from cavitation erosion, which may occur at some point over a range of operating conditions. At present no reliable method exists for determining the likelihood of sericus damage, although it is hoped that acoustic techniques may be developed. As it is uneconomic to avoid cavitation entirely, the risk of damage must be accepted, although the effects of cavitation can be minimized by various means or resisted by suitable choice of material. Air injection or the use of water barriers may reduce cavitation effects, but in most cases the problem is one of materials selection. Laboratory erosion tests have shown that materials best able to resist erosion include aluminium bronze, stainless steel, titanium alloys, Neoprene and Nylon. Recent attempts to correlate erosion data with mechanical properties of materials indicate that hardness and resilience are the best guides to erosion resistance. Although most experiments have been in cold water, temperature has a significant effect and at atmospheric pressure erosion rises to a maximum at about 50°C, and decreases towards boiling point. In non-aqueous liquids the problem is more complex, but nuclear research has stimulated several investigations into cavitation in such substances as liquid metals. Author

N68-32322 Alabama Univ., University.
HYDRODYNAMIC STABILITY IN GENERALIZED FLOW SYSTEMS
Martin Theophilus Jasper (Ph.D. Thesis) 1967 81 p
Available from Univ. Microfilms: HC $4.40/MF $3.00 Order No. 67-13243

This dissertation considers the hydrodynamic stability of flows which are referred to generalized coordinate systems. The analysis is based on an infinitesimal disturbance of a suitable periodic nature superimposed on the mean flow and is not restricted to parallel and approximately parallel flows. It is shown, for the class of flows characterized by the presence of a normal velocity component at opposed coordinate surfaces accompanied by vanishing tangential velocity components and a vanishing disturbance at those surfaces, that the hydrodynamic stability problem can be formulated as an ordinary differential equation of fourth order in terms of the metric coefficients and a single component of the disturbance amplitude. This equation corresponds in principle to the Orr–Summerfield Equation for parallel flow referred to rectangular coordinates. Dissert. Abstr.

N68-32331 California Inst. of Tech., Pasadena.
ON THE TURBULENT FLOW OF DILUTE POLYMER SOLUTIONS
Myles Alexander Walsh, III (Ph.D. Thesis) 1967 139 p
Available from Univ. Microfilms: HC $6.60/MF $3.00 Order No. 67-14355

This paper is concerned with the problem of explaining the anomalous decrease in turbulent skin friction observed in the turbulent flow of very dilute polymer solutions. The polymer molecule in solution is examined from a theoretical point of view, using the Rouse model. It is found that the model predicts that the molecule will locally store energy as a function of the local strain rate of the solution. The experimental evidence is reexamined and it is concluded that the anomalous decrease in turbulent momentum transport results because the molecules manage to alter the energy balance of the small disturbances at the edge of the viscous sublayer. By slightly altering this balance the molecules allow viscous dissipation to destroy disturbances which would have had sufficient energy to grow had the molecules not been present. Dissert. Abstr.

N68-32337 California Inst. of Tech., Pasadena.
PARTICLE FLUID MECHANICS IN SHEAR FLOWS, ACOUSTIC WAVES, AND SHOCK WAVES
Laurence Bei-yu Zung (Ph.D. Thesis) 1967 197 p
Available from Univ. Microfilms: HC $9.00/MF $3.00 Order No. 67-14369

Three different categories of flow problems of a fluid containing small particles are being considered here. They are: (I) a fluid containing small, non-reacting particles; (II) a fluid containing reacting particles; and (III) a fluid containing particles of two distinct sizes with collisions between two groups of particles. A numerical solution is obtained for a fluid containing small particles flowing over an infinite disc rotating at a constant angular velocity. It is a boundary layer type flow, and the boundary layer thickness for the mixture is estimated. The "inviscid" equation for a gas-particle mixture is linearized to describe the flow over a wavy wall. Corresponding to the Prandtl–Glauert equation for pure gas, a fourth order partial differential equation in terms of the velocity potential ϕ is obtained for the mixture. Using the boundary layer approximation, the initial development of the combustion zone

between the laminar mixing of two parallel streams of oxidizing agent and small, solid, combustible particles suspended in an inert gas is investigated. Dissert. Abstr.

N68-32339 Colorado State Univ., Fort Collins.
EFFECT OF SURFACE TEXTURE ON FALL BEHAVIOR OF CYLINDERS AND DISKS IN A QUIESCENT FLUID
Ashok Kumar (Ph.D. Thesis) 1967 184 p
Available from Univ. Microfilms: HC $8.40/MF $3.00 Order No. 67-13202

The effect of surface texture as it influences the fall behavior of cylinders and disks falling freely in quiescent viscous fluids has been studied. A Lagrangian study of two cylinders (one smooth and the other rough) along their fall paths has been made by a rather complete study of the mechanics of instability. A smooth disk which exhibited acceleration in different directions has also been studied in detail and the effect of virtual mass and acceleration was investigated. It was found that the fall pattern of freely falling cylinders and disks (smooth and rough) can be broadly classified under five main headings, i.e., stable fall, regular oscillations, gliding, glide-tumble, and tumbling. For stable fall, the average drag coefficient for rough cylinders was reduced 3.6 to 14 percent in comparison with the drag coefficient for similar smooth cylinders. Also, the average drag coefficient for rough disks was reduced 3.5 to 14 percent in comparison with the drag coefficient for similar smooth disks. Dissert. Abstr.

N68-32411*# Rice Univ., Houston, Tex.
METHOD OF PARTICULAR SOLUTIONS FOR LINEAR, TWO-POINT BOUNDARY-VALUE PROBLEMS. PART 1: PRELIMINARY EXAMPLES
Angelo Miele 1968 23 p refs
(Grant NGR-44-006-089)
(NASA-CR-96231; AAR-48, Pt. 1) CFSTI: HC $3.00/MF $0.65
CSCL 20D

Methods commonly employed for solving linear, two-point boundary value problems require the use of two sets of differential equations: the original set and the derived set. This derived set is the adjoint set if the method of adjoint equations is used, the Green's functions set if the method of Green's functions is used, and the homogeneous set if the method of complementary functions is used. With particular regard to high-speed digital computing operations, this report explores an alternate method, the method of particular solutions, in which only the original, nonhomogeneous set is used. As a preliminary example, a second-order system is considered, and the boundary-value problem is solved by combining linearly several particular solutions of the original, nonhomogeneous set. Both the case of an uncontrolled system and that of a controlled system are considered. Author

N68-32421 British Hydromechanics Research Association, Cranfield (England).
AN INTRODUCTION TO PRESSURE SURGES IN GAS-LIQUID MIXTURES
K. J. Enever 1967 10 p refs Presented at the 9th Members Conf., Cranfield, Sep. 1967
(SP-920)

This paper discusses the effect of the presence of gas in a liquid on the pressure rises which will occur after sudden changes in the flow. The theory of shock waves in gas/liquid mixtures is described and a brief description is given of a method being developed which makes use of a digital computer. Author

N68-32425 British Hydromechanics Research Association, Cranfield (England).
THE DEVELOPMENT OF A METHOD FOR USING ANALOGUE COMPUTERS IN SURGE ANALYSIS
P. G. Thomasson 1967 18 p refs Presented at the 9th Members Conf., Cranfield, Sep. 1967
(SP-921)

The partial differential equations describing water hammer are reduced to time difference equations, which can be manipulated by an analog computer equipped with time delay units. Since most general purpose analog computers do not possess a set of time delay units various designs of delay equipment are considered; rational fraction transfer function approximations and condenser storage techniques are studied in detail. The condenser storage technique is shown to be the most satisfactory and the computer solution of a simple problem is given. Author

N68-32436# Centre National de la Recherche Scientifique, Meudon (France). Laboratoire d'Aerothermique.
EXPERIMENTAL STUDY OF HYPERSONIC DIFFUSER IN RARIFIED GAS FLOW [ETUDE EXPERIMENTALE D'UN DIFFUSEUR EN ECOULEMENT HYPERSONIQUE DE GAZ RAREFIE]
Jean Allegre and Michel Raffin Jun. 1968 60 p refs In FRENCH; ENGLISH summary
(Rept.-68-4) CFSTI: HC $3.00/MF $0.65

Wind tunnel experiments were conducted to determine the compression mechanism of the flow in a hypersonic diffuser at low Reynolds number. Pitot probe surveys and wall pressure measurements in connection with glow discharge visualization were used to define the flow configuration from the nozzle exit to the diffuser exit, both with and without models in the test section. The effects of diffuser inlet geometry and model size on the diffuser performance were demonstrated. Optimum working conditions corresponding to a maximum pressure recovery factor of about 260 were investigated. K.W.

N68-32452 British Hydromechanics Research Association, Cranfield (England).
SOME EXPERIMENTAL RESULTS ON VANELESS DIFFUSERS FOR CENTRIFUGAL COMPRESSORS
S. Gahin (Coll. of Technol., Paisley) 1967 8 p refs Presented at the 9th Members Conf., Cranfield, Sep. 1967
(SP-913)

This paper is a summary of the results of a considerable amount of experimental tests carried out on the vaneless diffuser of a centrifugal compressor stage. These results have contributed to the understanding of the flow in this type of diffuser, and indicated the possible existance of some unknown phenomena. The results confirm that most of the centrifugal compressor or pump sufferings seem to be initiated in the impeller, nevertheless it has shown that modifications in the vaneless diffuser might relieve some of these sufferings. Author

N68-32459 British Hydromechanics Research Association, Cranfield (England).
EFFECT OF INLET AND OUTLET CONDITIONS ON PIPE AND DUCT COMPONENTS
D. J. Cockrell (Leicester Univ.) 1967 12 p refs Presented at the 9th Members. Conf., Cranfield, Sep. 1967
(SP-929)

The impedance of fluid circuit components depends on flow distribution as well as on the discharge. Variation of both the inlet and the outlet conditions will affect the distribution of the flow within the pipe or duct section. The Research Engineer is concerned with the identification and proper formulation of flow problems, while the Design Engineer is no less concerned with the application of his particular field of study of the parameters which will then be provided for him. All engineers have considerable difficulty in interpreting the work of other experimenters because of the sparse test data usually given in the published literature on

pipe and ducts flows. The paper illustrates how the variation of inlet and outlet conditions affects simple fluid circuit components. It suggests that there is a significant field of research to be undertaken if predictions of fluid circuit performance are to be made with higher orders of accuracy in the future than have been obtained in the past. Author

N68-32461 British Hydromechanics Research Association, Cranfield (England).
IMPROVED NPSH PERFORMANCE BY THE USE OF CAVITATING PUMPS
I. S. Pearsall (Natl. Eng. Lab.) 1967 24 p refs Presented at the 9th Members Conf., Cranfield, Sep. 1967
(SP-930)

Where suction conditions cannot be met by conventional pumps, supercavitating pumps or inducers may be used to give improved suction performance. If the duty is low head, these pumps can be used alone. If however greater heads are required they can be used as a first stage to a centrifugal pump. Of the two types the inducer produces higher heads and efficiencies, than the supercavitating pump, but is subject to greater erosion damage. Work on supercavitating pumps has concentrated on developing satisfactory design methods, but it has been shown that suction specific speeds over 30,000 can be achieved. Author

N68-32462 British Hydromechanics Research Association, Cranfield (England).
WEDGE TYPE PITOT-STATIC PROBES
T. B. Ferguson (Sheffield Univ.) and K. A. Al-Shamma (Sheffield Univ.) 1967 16 p refs Presented at the 9th Members Conf., Cranfield, Sep. 1967
(SP-919)

A wedge-type pitot-static probe is described that includes low speed characteristics over a range of wedge angles. This type of probe is considered suitable as a simple traverse instrument in turbomachine applications. It is relatively insensitive to tapping positioning because of its low pressure gradients at zero yaw, although it is sensitive enough to make an accurate yawmeter. Pressure distribution on wedges at zero yaw are discussed, along with yaw characteristics and end, pitch, and Reynolds number effects. Preliminary results indicate the wedge-type probe to be relatively insensitive to pitch, although studies at a wider range of wedge angles are considered requisite to a final conclusion. M.W.R.

N68-32511# Laboratoire de Physique Theorique et des Hautes Energies, Orsay (France).
TIME DEPENDENCE OF PAIR CORRELATION IN FLUIDS IN TERMS OF SELF DIFFUSION AND STATIC STRUCTURE
Juhani Kurkijaervi Jul. 1968 7 p refs
(Rept.-68/20) CFSTI: HC $3.00/MF $0.65

An attempt to describe the time dependence of the density-density correlation function of a simple fluid by a simple geometrical argument is presented. Results are compared with computer experiments. Author

N68-32516# Polytechnic Inst. of Brooklyn, N. Y. Dept. of Aerospace Engineering and Applied Mechanics.
A KINETIC (NON-LINEAR) THEORY OF TURBULENCE IN INCOMPRESSIBLE FLUIDS
Toyoki Koga Mar. 1968 34 p refs
(Contract Nonr-839(38); ARPA Order-529)
(PIBAL-68-5; AD-671835)

In principle, a turbulence field is to be governed by the Navier-Stokes equations. In order to avoid the difficulty of treatment due to the non-linear characteristics of the Navier-Stokes equations, one begins with the assumption that a turbulence field may be represented by a proper distribution of many elementary vortex lines, each of which, being a particular solution of the Navier-Stokes equations, exhibits full characteristics of the non-linear equations. Based on this assumption, an equation is introduced which governs the distribution of those elementary vortex lines, in the same way as the Liouville equation governs the distribution of particles. With respect to a two-dimensional field, it is shown that Taylors parabolic correlation mode for short distances and Kolmogoroffs 2/3-power correlation mode for moderate distances are unified to one correlation mode which is valid for the entire range of correlation distances. With respect to three-dimensional cases, introducing remarks are given. Author (TAB)

N68-32535 British Hydromechanics Research Association, Cranfield (England).
THE THIRD MILLENIUM
H. H. Anderson (Weir (G. J.) Ltd.) 1967 4 p Presented at the 9th Members Conf., Cranfield, Sep. 1967
(SP-916)

Two aspects of the possible changes in fluid machines over the next 30 years are the increase of power, speed, pressure, temperature of existing designs and the emergence of entirely new designs, metallurgy and plastics. Possible changes in the pump field are surveyed firstly with respect to increased consumer demand on present functions and secondly with respect to new and untried processes. Author

N68-32587# Centre National de la Recherche Scientifique, Meudon (France). Laboratoire d' Aerothermique.
CONTRIBUTION TO THE STUDY OF INSTABILITIES IN SOME MANY-PHASED SLOW FLOWS [CONTRIBUTION A L'ETUDE DES INSTABILITES DANS CERTAINS ECOULEMENTS LENTS POLYPHASIQUES]
Gerard Dupeyrat Jun. 1968 75 p In FRENCH
(REPT.-68-2) CFSTI: HC $3.00/MF $0.65

The theory of servomechanisms was used to study the stability of a unidimensional triphasic flow in a porous medium. The law of Darcy and perturbation of flow were considered, and the stability of the system was studied by the method of Hurwitz polynomials. The formalism of this method was then applied to the quadriphasic case. Criteria for the stability in triphasic flow and the evolution of flow fronts are discussed, including oscillatory regimes, coupling influence, and wave amplification. Linear stability criteria obtained for triphasic flow are generalized for polyphasic flow and for two miscible liquids. Two stability cases were studied in which the flow of one of the fronts underwent deformation; as was the case when the porous medium has a variable permeability of the parabolic type. Detailed mathematical models are evolved throughout the study, for which it is concluded that a restrictive-type model does not have to be used. Transl. by M.W.R.

N68-32602# Martin Co., Orlando, Fla.
INVESTIGATION OF JET TRANSITION PHENOMENA Final Report, 1 Jun. 1967–31 May 1968
C. P. McKenzie and D. B. Wall Jun. 1968 27 p refs
(Contract AF 49(638)-1725)
(OR-9442; AFOSR-68-1572; AD-671977)

The experimental investigation examines jet phenomena, gaseous and liquid, in small submerged and bounded jets. Its general objectives are to acquire experimental data and to develop mathematical expressions for predicting the behavior of fluidic elements and designs. Data are presented for circular nozzles of 0.25 to 4.6 mm and square nozzles of 0.5 to 1.0 mm, observed by Schlieren and Birefringent flow techniques at low Reynolds numbers compatible with miniature fluidic designs. Good correlation between compressible and incompressible flow is obtained. Three principal nondimensional terms are used to evaluate and correlate experimental results. They are Reynolds number, transition number (a relationship of nozzle diameter and length of laminar flow), and

momentum number (represented the interaction of two jets). Three sets of tests are described. One measures the transition from laminar flow to turbulence in single submerged jets. The second introduces a secondary jet flow to determine its effect upon transition and deflection of the primary jet. The third involves variations of nozzle geometry commonly used in fluidic elements: sidewall divergence, sidewall setback and reinjection curvature. These geometries provide feedback paths and reflecting surfaces, allowing the jet to produce premature transition. Author (TAB)

N68-32611# National Research Council of Canada, Ottawa (Ontario).

STABILITY OF A COLLAPSING GAS CAVITY IN A ROTATING LIQUID [OB USTOICHIVOSTI SKHLOPYVAYUSHCHEISYA GAZOVOI POLOSTI VO VRASHCHAYUSHCHEISYA ZHIDKOSTI]

V. K. Kedrinskii and G. M. Pigolkin. 1968. 7 p. Transl. into ENGLISH from Zh. Prik. Mekhan. i Techn. Fiz. (Moscow), v. 3, 1964 p 113–117
(NRC-TT-1309) CFSTI: HC $3.00/MF $0.65

An experimental investigation was conducted on the shape stability of a collapsing gas cavity formed in a rotating liquid and filled with air or a mixture of acetylene and oxygen. In the latter case a determination was made of the influence of ignition of the mixture at the instant of maximum compression on the stability of the cavity shape on subsequent expansion. An attempt was made to construct some mechanisms for the phenomena observed. Author

N68-32628# Laboratoire d'Aerothermique du C.N.R.S., Bellevue (France).

REPORT OF STUDIES ON SUPERSONIC JETS IN RARIFIED ATMOSPHERE [ETAT DES ETUDES SUR LES JETS SUPERSONIQUES EN MILIEU RAREFIE]

Alain Beaune. Dec. 1967. 41 p. refs. In French
(Rept.-67-11) CFSTI: HC $3.00/MF $0.65

The aerodynamic characteristics of nonviscous gas jets in rarefied media and in thermodynamic equilibrium are reviewed, as are the chemical and physical processes related to real fluid jets. A free jet in plane or axial symmetry is discussed; and the impact of jets on nondeformable surfaces and the interaction of a jet with other flow are considered. Viscosity, diffusion, radiation, and relaxation phenomena that can result in nonequilibrium flow are treated. Transl. by M.W.R.

N68-32662# Ohio State Univ., Columbus. Aeronautical and Astronautical Research Lab.

AN EXPERIMENTAL STUDY OF THE FLOW IN A LOW-PRESSURE SWIRL CHAMBER Summary Technical Report, 15 Oct. 1963–31 Oct. 1966

John D. Lee. Wright-Patterson AFB, Ohio. ARL. Apr. 1968. 39 p. refs
(Contract AF 33(615)-1083)
(ARL-68-0072; AD-671533)

An experimental study was conducted to determine the nature of the flow in a low-pressure swirl-flow chamber which provided endwall boundary layer control by injection or reverse-flow capabilities as optional. For part of the investigation water flows were used while dye streams were observed in attempts to determine streamline patterns; for the remainder, air flows were examined by means of a special probe from whose measurements the velocity profiles were determined. The chamber flow consisted of three main zones: the core, the main body and the boundary layers. The core, which rotated wheel-like, contained an inner, nearly-stagnant core and an outer sheath which exhausted out the chamber exit. The outer body of fluid moved in a vortex-like manner but contained low-order axial and radial flows which resulted in unexpected cell movements. The boundary layers on the endwalls spiralled inward toward the center, as dictated by the radial pressure gradient, but were effectively reversed by the endwall injection. The mode of injection and the overall pressure ratio were found to have strong affects upon the flow but there was little or no influence from variations in Reynolds number and from a number of minor geometric changes. Author (TAB)

N68-32699# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

PROBLEM OF SLANTING OF THE STREAMLINE FLOW AROUND A CURVILINEAR ARC WITH DEVELOPED CAVITATION [ZADACHA O KOSOM OBTEKANII KRIVOLINEYNOY DUGI S RAZVITOY KAVITATSIYEY]

A. G. Terent'yev. 14 Sep. 1967. 20 p. Transl. into ENGLISH from Tr. Seminara Po Gidrodin. Krayev. Zadacham. (Kazan), no. 2, 1964 p 187–200
(FTD-MT-24-265-67; AD-671736)

Steady-state plane cavitation flow of a stream of an ideal incompressible and weightless fluid around a curvilinear arc of a given form according to a scheme with central symmetry is examined. According to this scheme, the domain bounded by the arc streamed around by jets, which are detached from the ends of the arc and which come together at a finite distance from it, is a domain with central symmetry. The problem is solved by the method of the theory of functions of a complex variable with the use of conformal mapping and an auxiliary parametric complex plane. The problem reduces to the solution of an integro-differential equation, which generalizes the Will equation in the theory of jets. The solution of this equation, which is equal to the angle formed by the axis of the abscissas with the tangent to the arc, is constructed in the form of a series in powers of a small parameter, which is proportional to the curvature of the arc and the cavitation number. The convergence of this series is demonstrated for sufficiently small values of the parameter of the expansion. Approximate formulas are given for determining the flow according to the arc parameters and for calculating the lift and drag. These formulas are given for arcs with small curvature and for small cavitation numbers (so-called developed cavitation). The cavitation flow around an arc of a circle is studied in more detail. Author (TAB)

N68-32700# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

CALCULATION OF CONDENSATION SHOCKS IN A RELATIVELY LOW PRESSURE RANGE [RASCHET SKACHKOV KONDENSATSII V OBLASTI NEBOL'SHIKH DAVLENIY]

V. F. Stepanchuk and G. A. Saltanov. 29 Aug. 1967. 13 p. refs. Transl. into ENGLISH from Inzh.-Fiz. Zh. (Moscow), v. 9, no. 4, 1965 p 438–443
(FTD-HT-67-175; AD-671588)

In general, in a stream of wet steam there appear oblique condensation jumps. A condensation jump is followed by a bunch of rarefaction waves, the first characteristic of which coincides with the front of the jump. The velocity of sound in the region of small moisture contents is sufficiently close to the velocity of sound in dry saturated steam which, in turn, is determined as a = (kRT) to the 1/2 power. The equation pV=RT is applicable to the supercooled steam up to the condensation jump and to the saturated steam after the condensation jump. The article makes the following simplifying assumption: in the region of small pressures (for water vapor the static pressure in front of the condensation jump is less than 50,000 newtons/sq. m), it can be assumed that the saturation temperatures before and after the condensation jump are equal. This applies also to the latent heat of evaporation. In calculation of a condensation jump, the given quantities are p sub o, T sub o, and the geometry of the nozzle. The problem can be solved either on the basis of the kinetics of the phase transitions in a stream of supercooled steam, which leads to difficult calculations, or on the basis of an empirical expression. Further calculation of the

condensation jump is carried out on the basis of the equations of gas dynamics: the equation of continuity, the momentum equation, and the energy equation. The results are correlated and presented in the form of a nomograph for the easy calculation of the condensation jumps. Author (TAB)

N68-32723# Army Engineer Research and Development Labs., Fort Belvoir, Va.
INFLUENCE OF ANGULAR AREAS OF CHANNELS ON FRICTION AND THERMAL EXCHANGE
V. K. Migai May 1968 12 p refs
(T-1926-68; AD-671701)

In this article are presented the results of the experimental research in hydraulic resistance and convective thermal exchange in the channels with cross-sections containing angular areas. It also presents the method of computation of the thermal exchange in such channels during turbulent flow. Author (TAB)

N68-32737 Rice Univ., Houston, Tex.
THE FIFTH VIRIAL COEFFICIENT OF A HARD SPHERE GAS AND A HARD DISK GAS
Albert Pei-hsin Yu (Ph.D. Thesis) 1967 107 p
Available from Univ. Microfilms: HC $5.40/MF $3.00 Order No. 67-13139

The fifth virial coefficient (B_5) of a hard sphere gas and of a hard disk gas have been evaluated with high accuracy. In the Mayer cluster theory, the fifth virial coefficient is expressed as a sum of 238 irreducible cluster integrals of 10 types. However, advantage is taken of an alternative formulation involving two center open cluster integrals. The relation between the two different formulations was explored and one type of the irreducible Mayer cluster was evaluated in terms of the corresponding two-center open cluster. Three different methods were used in the process of evaluating different types of cluster integrals. In the case of the hard sphere system, a Fourier transformation technique was used to evaluate all but one of the 10 different types of irreducible clusters. Dissert. Abstr.

N68-32781# Massachusetts Inst. of Tech., Cambridge. Engineering Projects Lab.
PRESSURE WAVE PROPAGATION IN ADIABATIC TWO-PHASE FLOW
R. G. Evans, S. W. Gouse, Jr., and A. E. Bergles May 1968 138 p refs
(Contract Nonr-3963(15))
(DSR-74629-2; AD-671823)

At present there is a lack of reliable data on the propagation velocity of pressure waves in flowing gas-liquid two-phase systems in the void fraction range from roughly fifty to ninety-five per cent. Classical methods of measuring acoustic velocity such as the acoustic interferometer are shown to be unsuitable for this void fraction range. A technique was developed in which the velocity and strength of shock waves traveling in the mixture was measured. Then by extrapolating the results to a shock wave pressure ratio of unity, the local acoustic velocity is obtained. Measurements of the acoustic velocity were made in a flowing air-water mixture near the inlet and exit of a half-inch diameter vertical pipe fourteen feet in length. These measurements were correlated with the results of void fraction measurements made with quick-closing valves and phase distribution measurements made with an electrical resistance probe. The effect of inlet conditions was investigated by injecting the water along the wall through a porous section, and then repeating the measurements with the water injected at the center with an axial nozzle. Mass velocities used were from 2.57 to 1,310,000 lb/hr (sq. ft.), void fractions measured were from 0.565 to 0.981, and flow regimes observed were slug, annular, and mist flow. The data indicate that the propagation of acoustic signals is done primarily through the core of the flow. Hence conditions in the core, particularly density inhomogenaities and inlet effects, govern the propagation characteristics. The core propagation model developed offers a logical explanation of the disagreement between existing data and theory. Author (TAB)

N68-32791 Princeton Univ., N. J.
VELOCITY PROFILES OF A NON-NEWTONIAN FLUID IN HELICAL FLOW
David Richard Rea (Ph.D. Thesis) 1967 147 p
Available from Univ. Microfilms: HC $7.00/MF $3.00 Order No. 67-13504

The flow behavior of a 3 percent solution of polyisobutylene (Vistanex L-100) in Decalin was examined experimentally in helical flow at 25°C. Helical flow was generated by simultaneously imposing an axial pressure gradient and a rotational torque on the fluid as it passed between concentric cylinders. Measurements of velocity profiles and volumetric flow rate were made for a given pressure drop and outer cylinder rotational speed. To measure velocity profiles, a flow visualization technique was developed that used light scattered from tracer particles in the fluid to reveal the flow patterns. The experimental measurements were compared with predicted values based on the theory of simple fluids and a Poiseuille flow characterization of the viscosity-related material function. The power law was used to describe this material function. Substantial agreement was found between predicted and experimental values of the velocity field indicating that for the conditions studied the polyisobutylene solution behaved in a manner consistent with that of a simple fluid. Dissert. Abstr.

N68-32808# Princeton Univ., N. J. Aerospace and Mechanical Sciences Dept.
MICROPOLAR FLUIDS WITH STRETCH
A. Cemal Eringen Apr. 1968 36 p refs
(Contract N00014-67-A-0151-0004)
(TR-3; AD-671881)

Equations of motion, constitutive equations, and boundary conditions are derived for a class of micropolar fluids which can stretch or contract. These fluids respond to intrinsic rotational motions and spin inertia and therefore can support couple stress and body couples. In addition, microelements of such fluids can stretch or contract so that intrinsic extensional motions are possible. It is conjectured that the model constructed will have applications in liquid crystals, fluids with polymeric additives, and turbulent motions of Newtonian fluids. Thermodynamical restrictions are studied in detail, and field equations are obtained for the density, microinertia, velocity vector, microrotation vector, and the microstretch. Author (TAB)

N68-32810# Naval Academy, Annapolis, Md. Dept. of Engineering.
SYMPOSIUM ON NUCLEATION PHENOMENA IN GAS DYNAMICS Abstracts of the Proceedings
Andrew A. Pouring Dec. 1967 39 p refs
(AD-671907)

The objective of the symposium was to have a critical discussion of the present status of nucleation theory in nozzles, molecular beams and other flows. Several invited lectures on nucleation and condensation theory in such flows were presented. The remainder of the time was used for discussion of the lectures, short presentations by the symposium participants and a round table discussion. Author (TAB)

N68-32900# California Inst. of Tech., Pasadena. Graduate Aeronautical Labs.
THEORY OF LAMINAR VISCOUS-INVISCID INTERACTIONS IN SUPERSONIC FLOW

John Michael Klineberg (Ph.D. Thesis) 1968 214 p refs
(AFOSR-68-1569; AD-671883)

The investigation is concerned with those fluid-mechanical problems in which the pressure distribution is determined by the interaction between an external, supersonic inviscid flow and an inner, laminar viscous layer. The boundary-layer approximations are assumed to remain valid throughout the viscous region, and the integral or moment method of Lees and Reeves, extended to include flows with heat transfer, is used in the analysis. The general features of interacting flows are established, including the important distinctions between subcritical and supercritical viscous layers. The eigensolution representing self-induced boundary-layer flow along a semi-infinite flat plate is determined, and a consistent set of departure conditions is derived for determining solutions to interactions caused by external disturbances. Complete viscous-inviscid interactions are discussed in detail, with emphasis on methods of solution for both subcritical and supercritical flows. The method is also shown to be capable of predicting the laminar flow field in the near wake of blunt bodies. Results of the present theory are shown to be in good agreement with the measurements of Lewis for boundary-layer separation in adiabatic and non-adiabatic compression corners, and with the near-wake experiments of Dewey and McCarthy for adiabatic flow over a circular cylinder. Extensions of the method to flows with mass injection at the surface and to subsonic interactions are indicated. Author (TAB)

N68-32960 California Inst. of Tech., Pasadena.
INTEGRAL THEORY FOR TURBULENT BASE FLOWS AT SUBSONIC AND SUPERSONIC SPEEDS
Irwin Emanuel Alber (Ph.D. Thesis) 1967 142 p
Available from Univ. Microfilms: HC $6.80/MF $3.00 Order No. 67-14359

The integral near wake analysis of Reeves and Lees developed for supersonic laminar base flows is extended to the case of fully turbulent separated adiabatic flow behind a rearward facing step at both subsonic and supersonic speeds. A turbulent eddy viscosity model is formulated for the shear stress scaling of the dissipation integral in the mechanical energy equation. It is shown that the eddy viscosity can be described simply by one incompressible constant (valid for both shear layers and wakes) and one reference density ρr. Using a compressibility transformation, theoretical solutions for the spreading rates of free shear layers are found to agree with experiment when the reference density is chosen to be the centerline density for the wake flow. Dissert. Abstr.

N68-32967# Stanford Univ., Calif. Dept. of Mechanical Engineering.
AN INTEGRAL PREDICTION METHOD FOR TURBULENT BOUNDARY LAYERS USING THE TURBULENT KINETIC ENERGY EQUATION
E. A. Hirst and W. C. Reynolds Jun. 1968 171 p refs
(Contract AF 49(638)-1278; Grant NSF GK-1334)
(MD-21; AFOSR-68-1568; AD-671947)

A new integral method was devised for predicting the development of two-dimensional, incompressible, stationary turbulent boundary layers. This new method differs from the older integral methods in that it explicitly accounts for the turbulence via a characteristic turbulent velocity scale. A model of the turbulent kinetic energy integral equation is used to keep track of this turbulence scale. The model equation is developed on the basis of intuition, physical reasoning and some experimental evidence. In this new method the model equation is solved in conjunction with the momentum integral equation and the entrainment equation. A two-layer velocity profile is used. The law of the wall is assumed valid in the inner region and Coles law of the wake is assumed valid in the outer region. The two profiles are joined by asymptotic matching; this gives an implicit equation for the skin friction. The predictions using this method are in excellent agreement with the measurements for fourteen different experimental boundary layers. Author (TAB)

N68-32982*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
STUDY OF OPTICAL RADIATION IN THE WAVELENGTH REGIONS OF 0.4216 μ, 0.4278 μ, 0.4825 μ, AND 0.5165 μ BEHIND NORMAL SHOCK WAVES IN A SIMULATED MARTIAN ATMOSPHERE
Anthony P. Modica (Avco Corp.), Harry B. Dyner (Avco Corp.), and James O. Arnold Washington Aug. 1968 10 p refs
(NASA-TM-X-1634) CFSTI: HC $3.00/MF $0.65 CSCL 20D

Shock-tube measurements of equilibrium and nonequilibrium radiation in a 50-percent CO_2–50-percent N_2 gas mixture are analyzed and compared to theoretical estimates and other measurements. The ratio of the integrated radiation from the nonequilibrium zone behind the normal shock wave to the equilibrium radiation from an equal volume of gas is of particular interest. The measurements show no appreciable differences in nonequilibrium enhancement from four different spectral regions. Author

N68-33053 State Univ. of New York at Buffalo.
CHEMICAL NON-EQUILIBRIUM IN VISCOUS FLOWS
Jeffrey Annin Moore 1967 355 p
Available from Univ. Microfilms: HC $16.00/MF $4.55 Order No. 67-13352

Vehicles which are moving at hypersonic speeds through the earth's atmosphere are considered. The air is viewed as a reacting seven component gas mixture in chemical non-equilibrium (i.e., N_2, N, O_2, O, NO, NO^+ and e^-), and numerical solutions to the conservation equations are obtained for two distinct portions of the viscous flow field about both axisymmetric and two-dimensional bodies. The laminar boundary layer with surface catalysis and foreign gas injection is examined. Illustrative calculations are presented for the discontinuous injection of helium, argon and xenon along the surface of a sharp cone, and catalytic recombination of the oxygen and nitrogen atoms is studied at the stagnation point of a hemisphere-cylinder. In addition, the role of thermal diffusion is examined with and without injection effects. Dissert. Abstr.

N68-33054*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
DRAG DUE TO TWO-DIMENSIONAL SURFACE ROUGHNESS IN A TURBULENT BOUNDARY LAYER AT MACH 3 WITH AND WITHOUT HEAT TRANSFER
William J. Monta, K. R. Czarnecki, and William D. Deveikis Washington Sep. 1968 41 p refs
(NASA-TN-D-4746) CFSTI: HC $3.00/MF $0.65 CSCL 20D

An investigation was conducted on an ogive-cylinder model to determine the effect of heat transfer on the drag due to two fabrication roughness shapes (steps with grooves and circular arc waves) at Reynolds numbers from 36×10^6 to 195×10^6. The results indicate only a slight effect of heat transfer and Reynolds number upon the roughness drag for the two configurations of the investigation. The zero heat transfer data are in good agreement with previously published results. The step roughness drag is correlated on the basis of a step-height Reynolds number and is in good agreement with both existing data and an existing prediction method based on effective dynamic pressure. For the wave-shaped wall, a nondimensional drag parameter was found to be a function of the ratio of roughness height to boundary layer thickness for a constant value of the roughness thickness ratio h/l. At the lower values of h/l, the parameter is a unique function of the ratio of roughness cycle length to boundary layer thickness. Author

N68-33058*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
FINITE AMPLITUDE WAVES IN FLUID-FILLED ELASTIC TUBES: WAVE DISTORTION, SHOCK WAVES, AND KOROTKOFF SOUNDS
Richard M. Beam Washington Sep. 1968 52 p refs
(NASA-TN-D-4803) CFSTI: HC $3.00/MF $0.65 CSCL 20D

The Lagrangian form of the one-dimensional equations of motion for a fluid-filled elastic tube is developed. The resulting nonlinear equations are combined with a general nonlinear internal pressure cross sectional area relation for the tube to obtain the finite amplitude wave equation. After determination of the tube pressure–area relation which leads to a linear wave equation, a solution for the general wave equation is presented. The solution is applicable for simple waves in tubes with general pressure–area relations. The solution is then used to develop criteria for the steepening and nonsteepening of finite amplitude waves. The theory is further developed to include the calculation of wave distortion. The criterion for a sharp wave is derived and the critical length of tube required for a sharp wave to develop is determined. The propagation of the resulting sharp wave or shock wave is considered. The velocity and the energy loss formulas for the shock wave are developed. Finally, the analysis and experimental results are used to support new hypotheses for the mechanism and source of the Korotkoff sounds which have a major role in the indirect determination of blood pressure. Author

N68-33071 Polytechnic Inst. of Brooklyn, N. Y.
ON A BOUNDARY LAYER CONTROL PROBLEM OF PRANDTL
Edward James Miranda (Ph.D. Thesis) 1967 74 p
Available from Univ. Microfilms: HC $4.00/MF $3.00 Order No. 67-13409

The incompressible boundary layer and the compressible boundary layer, for a Prandtl number of unity and a linear viscosity-temperature relation, are analyzed on the basis of two integro-differential equations in conjunction with a fifth degree velocity profile. The velocity distribution external to the boundary layer is assumed to be linearly retarded. The present analysis concerns itself with the problem posed by Prandtl, i.e., the determination of the distribution of suction in order to maintain zero skin friction from separation and beyond. Accordingly, the analysis considers two regions, the region before separation (impermeable region) and the region from separation and beyond (permeable region). The analysis is a two-parameter technique involving a momentum integral equation and an energy integral equation both of which are derived in the main text. Dissert. Abstr.

N68-33072 University of Southern Calif., Los Angeles.
AN INVESTIGATION OF ONE-DIMENSIONAL SINGLE COMPONENT TWO-PHASE NOZZLE FLOW WITH DISTRIBUTED DROPLET SIZE
Albert Theodore Stell (Ph.D. Thesis) 1967 163 p
Available from Univ. Microfilms: HC $7.60/MF $3.00 Order No. 67-13762

This dissertation studies the theoretical behavior of a single component, two-phase flow of steam and water droplets through nozzles. The number density of the evaporating and accelerating water droplets are assumed to be low so that droplet-droplet collision and coalescense are negligible. Based on experimental observation the initial size distribution of droplets is chosen to be Gaussian, but due to evaporation this distribution is considerably distorted further downstream. It is also assumed that the flow is one-dimensional, and the entire gas phase is inviscid and non-heat conducting except for the drag and heat transfer caused by the droplets. Both subsonic and supersonic flows through conical diffusers and hyperbolic converging-diverging nozzles have been analyzed and compared with equivalent isentropic flows of single phase systems. Dissert. Abstr.

N68-33075 Rochester Univ., N. Y.
THE EFFECT OF PLANE STAGNATION FLOW ON THE STEFAN PROBLEM
Roger J. LaCasse (Ph.D. Thesis) 1967 127 p
Available from Univ. Microfilms: HC $6.20/MF $3.00 Order No. 67-13632

The problem solved is that of steady melting of a semiinfinite body which is placed perpendicular to a stream of hot fluid. The solid and the fluid are of the same material, the properties of which are identical and constant. The solution is restricted to the stagnation region of plane flow. The melting of the body produces an upflow at the melt interface. The material released in melting convects heat away from the melt interface. The upflow forms a self-regulating heat and mass transfer shield. The governing energy and momemtun equations are solved by numerical methods and by the use of Karman–Pohlhausen integral methods. The integral methods are compared to the numerical procedures for ease of calculation and accuracy. Various velocity profiles are used in the integrated form of the momentum equation. Dissert. Abstr.

N68-33076# Sandia Corp., Livermore, Calif. Analytical Div.
NUFF: A PROGRAM FOR THE NUMERICAL COMPUTATION OF COMPRESSIBLE FLOW FIELDS
A. F. Emery Jun. 1968 86 p refs
(Contract AT(29-1)-789)
(SCL-DR-67-66) CFSTI: HC $3.00/MF $0.65

The generalized Eulerian code for the computation of supersonic transient flow fields is described. The code is capable of analyzing two-dimensional plane and axisymmetric flow in cylindrical coordinates, two-dimensional plane flow in polar coordinates, and two-dimensional axisymmetric flow in spherical coordinates. Detailed instructions for the use of the code are given, and solutions to some typical problems are illustrated. Author (NSA)

N68-33084*# General Electric Co., Philadelphia, Pa. Missile and Space Div.
FLOW FIELD COMPUTATIONS FOR BLUNT BODIES IN PLANETARY ENVIRONMENTS (EQUILIBRIUM) Final Report
P. Hsueh 5 Jan. 1968 51 p refs Prepared for JPL Suppl.
(Contracts NAS1-100; JPL-951647)
(NASA-CR-98375) CFSTI: HC $3.00/MF $0.65 CSCL 20D

Inviscid static and dynamic stability parameters are obtained for a family of blunted 45 degree half angle cones at Mach 10 for both ideal gas and equilibrium air flows. The results are obtained by utilization of the flow field computer programs which use appropriate numerical methods to determine both steady and unsteady inviscid flow fields. For the real gas case, the shock layer flow downstream of the sonic line on the sphere is everywhere supersonic, and no difficulty was encountered in the computations. For the ideal gas case, there exists a subsonic layer near the conical part of the body surface where the flow is otherwise generally supersonic. An approximation enabled the completion of the computation for this case. The effect of the approximation is found to be significant for bodies of large bluntness ratios but is negligible for bodies of small bluntness ratios. Author

N68-33109 Polytechnic Inst. of Brooklyn, N. Y.
DENSE PHASE HORIZONTAL CONVEYING OF AIR-SOLID MIXTURES
Samavedam Srinivasachari (Ph.D. Thesis) 1967 247 p
Available from Univ. Microfilms: HC $11.25/MF $3.20 Order No. 67-13423

This investigation was undertaken principally to study the dense phase horizontal transport characteristics of particulate materials in the region of full dense phase or mass flow. The present investigation was particularly concerned with the interrelationships of solid and gas flow rates, solids-to-gas ratio, pressure drop and the magnitude of the frictional wall resistance accompanying such flow. In addition to the above main purpose of this investigation it was intended to study the qualitative and possibly quantitative definition of the transition regions from mass flow to slug flow and from slug flow to flow across a salted layer of solids. Dissert. Abstr.

N68-33121# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

THE MOTION OF A CONE IN A LIQUID OF FINITE DEPTH [DVIZHENIYE KONUSA V ZHIDKOSTI KONECHNOY GLUBINY]

V. A. Yeroshin and V. B. Poruchikov *In its* Moscow Univ. Herald. Ser. 1: Math., Mech., No. 2, 1964 6 Jun. 1964 p 51-58 refs (See N68-33115 20-19)

The authors investigate the motion of a cone in a liquid of finite depth toward its free surface; in particular, they treat the cases of motion of a cone in an oscillating liquid and vertical penetration of a cone into a liquid of depth h. The cone moves under the effect of a force F_0 with initial velocity V_0. In each case the problem is reduced to consideration of the three-dimensional Laplace equation subject to certain boundary conditions. In the case of vertical penstration, the force for which the cone will move with constant velocity V_0 is found. Author

N68-33141 Colorado State Univ., Boulder.

BOUNDARY LAYER SEPARATION

Chang-yu Liu (Ph.D. Thesis) 1967 126 p

Available from Univ. Microfilms: HC $6.20/MF $3.00 Order No. 67-13205

The general boundary layer separation phenomena, laminar or turbulent, is treated as a steady or an unsteady separation. The time average of the wall shear of a steady separation is zero, while the time average of the wall shear of an unsteady separation is not zero. A new systematic family of laminar boundary layer velocity profiles was computed from a computer program. The flow model used has an equivalent constant pressure region in the leading edge, then a linear decrease of freestream velocity is assumed to separate the boundary layer from the solid wall. A method to evaluate the properties of steady laminar separation is derived. In addition, a method based on an inner and outer velocity distribution was developed as an aid in the prediction of the position of steady turbulent separation. The potential velocity distribution for a continuous steady separating flow was also obtained. Dissert. Abstr.

N68-33142# Bettis Atomic Power Lab., Pittsburgh, Pa.

FLOW CALCULATION FOR LOSS OF FLOW AND OTHER TRANSIENTS FROM VENTURI TUBE PRESSURE MEASUREMENTS

W. A. Coffman and T. A. Porsching Jan. 1968 37 p refs

(Contract AT(11-1)-GEN-14)

(WAPD-TM-735) CFSTI: HC $3.00/MF $0.65

A differential equation is formulated to represent mathematically the momentum transformations which occur in transient fluid flow between the approach and throat pressure tap planes of a Venturi tube. The equation is solved numerically for the transient flow rate by means of a digital computer program. NSA

N68-33143# California Inst. of Tech., Pasadena. Graduate Aeronautical Labs.

CONSTANT-PRESSURE LAMINAR MIXING OF A SHEAR LAYER WITH A QUIESCENT FLUID

Chia-Chun Chao (M.S. Thesis) Jun. 1968 75 p refs

(Contract AF 49(638)-1298)

(AFOSR-68-1567; AD-671966)

The constant-pressure laminar mixing of an initial shear layer with a quiescent fluid is studied theoretically. The line of singularities at the starting point is removed by abandoning the conventional restriction that the dividing streamline must coincide with the x-axis. Instead, the shape of this streamline in the near-field is determined by properly matching inner and outer flow regions so as to cancel any additional induced normal velocity and pressure disturbances in the outer flow. The far-field is obtained by applying the momentum integral technique beginning with the profiles determined by the near-field solution some distance downstream of the start of mixing. Universal functions are obtained that enable the progress of the mixing process to be followed both for a Blasius initial profile and an initial profile with a finite slip. Author (TAB)

N68-33165*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

LIQUID DROPS: NUMERICAL AND ASYMPTOTIC SOLUTIONS OF THEIR SHAPES

Kenneth J. Baumeister and Thomas D. Hamill Washington Sep. 1968 34 p refs

(NASA-TN-D-4779) CFSTI: HC $3.00/MF $0.65 CSCL 20D

The shapes of liquid drops resting on flat surfaces were determined by a Runge-Kutta solution of the Laplace capillary equation. A characteristic length equal to the square root of surface tension divided by the product of density and gravity was used to nondimensionalize the numerical results. In addition, asymptotic solutions for small and large drops were combined to give explicit expressions for the maximum drop height and radius. These correlations apply for the complete range of liquid volumes and contact angles. Author

N68-33195*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

APPLICATION OF THE METHOD OF INTEGRAL RELATIONS TO THE CALCULATION OF INCOMPRESSIBLE TURBULENT BOUNDARY LAYERS

John D. Murphy and William C. Rose [1968] 53 p refs Presented at the AFOSR-IFP-Stanford Symp. on Calculation Methods for Turbulent Boundary Layers, Stanford Univ., 19-23 Aug. 1968

(NASA-TM-X-61169) CFSTI $3.00 CSCL 20D

The present investigation was carried out to determine the efficiency and accuracy of a moment method as applied to the calculation of incompressible turbulent boundary layers. This method, at least conceptually, promises to be more accurate than the classical von Karman integral methods while requiring less computing time than previously employed finite difference methods. The moment method employed in the present study is popularly known as the "method of integral relations", following Dorodnitsyn (1960). Briefly, the mathematical procedure employed is to approximate the actual solution to a differential equation, where the solution is given by an infinite series (hence, the solution is said to lie in an infinite dimensional vector space). The approximation is taken in the form of a partial sum of the infinite series, thus placing the approximate solution in a finite dimensional vector space. This finite dimensional space is completely described by a system of coordinate vectors (normally referred to in moment methods as weighting functions) in that any element may be expressed as a linear combination of the coordinate vectors. Author

N68-33244*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

CALCULATION OF MEAN AND FLUCTUATING PROPERTIES OF THE INCOMPRESSIBLE TURBULENT BOUNDARY LAYER

Ivan E. Beckwith and Dennis M. Bushnell [1968] 28 p refs Presented at the Conf. on Computation Methods in Turbulent Boundary Layers, Stanford, Calif., 18-24 Aug. 1968

(NASA-TM-X-61170) CFSTI: HC $3.00/MF $0.65 CSCL 20D

The conservation equations for mass, mean momentum, and turbulent kinetic energy for the incompressible turbulent boundary layer have been solved by a finite difference procedure. Mathematical models developed by Glushko for the production, dissipation, and diffusion of the turbulent kinetic energy in the flat plate boundary layer have been modified and used to calculate a

nonequilibrium boundary layer subjected initially to a large adverse pressure gradient which is followed by a run of constant pressure. Comparisons of both mean and fluctuating flow properties have indicated generally good agreement between the calculated results and experimental measurements of Goldberg's. The best overall agreement with data was obtained by reducing the scale of turbulence in the outer part of the boundary layer to about 70 percent of the flat plate values as used by Glushko. The calculations have indicated that further simple modifications to the turbulence should improve the accuracy of predictions for the Goldberg data. It is expected that predictions of equal accuracy should be possible for other arbitrary pressure distributions ana wall boundary conditions. Author

N68-33258# Pisa Univ. (Italy). Inst. of Aeronautics.
PENETRATION AND INTERACTION OF A TRANSVERSE JET AND A SUPERSONIC STREAM Final Report
Enrico Pistolesi and Marino Marini May 1968 44 p refs
(Grant AF-EOAR-47-65)
(AFOSR-68-1419; AD-671508)

The interaction of a transverse jet injected into supersonic main stream is examined. The jet trajectory and the shape of the jet cross section are defined. The characteristics of the bow shock wave produced by the jet in the main stream are calculated. The value of the stand-off distance between the shock wave and the jet and the means to correlate the shock wave and the jet shape are obtained. Finally, the force induced by the jet on the wall from which it issues is calculated. Author (TAB)

N68-33284 British Hydromechanics Research Association, Cranfield (England).
DEVELOPMENTS IN WALL REATTACHMENT THEORY
D. G. Mitchell (Birmingham Univ.) Oct. 1967 9 p refs
(RR-927)

The report gives reasons for the present discontinuation of the hydrodynamic theory. Modifications are made to the jet profile in an original hydraulic theory for reattachment bubble prediction, and the effect of jet spread parameter is discussed. Author

N68-33308# Von Karman Inst. for Fluid Dynamics, Rhode Saint-Genese (Belgium).
TURBULENT SEPARATED FLOWS
H. H. Korst (Illinois Univ., Urbana) Apr. 1967 292 p refs Presented at Lectures on Short Course on Separated Flows, 17–28 Apr. 1968
(VKI-CN-66b) CFSTI: HC $3.00/MF $0.65

Separation is considered as a boundary value problem, and separation and wake flow as an entity in a textbook on turbulent separated flows. A chapter on attached boundary layer deals with laminar-turbulent compressible boundary layer with pressure gradient in the external flow, separation criteria, turbulent eddy viscosity, and includes some practical examples. The free interaction concept is related to wake flow mechanisms and transition from an attached boundary layer to a free shear layer is discussed. A single stream mixing base flow model is presented, as is a theoretical model for separated flows. Confluence of two supersonic jet boundaries is discussed, and attention is given to both external and internal flow problems. Separated flows with finite wake velocities are described, and cavity flow, dissipative flow, and heat transfer models are presented. Some related experimental results are included, and numerous graphs illustrate these findings. M.W.R.

N68-33351# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
SYSTEM OF PLANE TURBULENT JETS
I. S. Makarov and B. G. Khudenko *In its* J. of Eng. Phys., Vol. 9, No. 2, 1965 2 Nov. 1967 p 1–8 refs (See N68-33350 20-33)

The results are given of investigations of the mixing of five plane turbulent air jets, flowing out into the atmosphere from slit nozzles. Identical slits (8×30 mm) were placed equidistant from each other (30 mm). The flow rate, temperature, concentration of carbon dioxide, and the direction of flow at various distances from the nozzle cuts (up to 350 mm) were investigated in the resultant flow. The air being fed into nozzles 2 and 4 was heated to a maximum of 80°C. It is found that heat exchange in the jet begins long before the boundaries of the individual jets intersect. After the mixing of the jets (cross section, 52 mm) the temperature changes monotonically from maximum to minimum. Quantitative processing of the experimental data shows a total analogy in the processes of heat exchange and mass exchange in the system of jets. The differences noted in the characteristics of the individual jets are presented and discussed. Author

N68-33478 Washington Univ., Seattle.
A STUDY OF WAVE MOTION IN A VISCOUS RADIATING GAS
Louis Hilmer Bangert (Ph.D. Thesis) 1967 148 p
Available from Univ. Microfilms: HC $7.00/MF $3.00 Order No. 67-14147

This study considers both infinitesimal and finite amplitude wave motion in a viscous, radiating gas. The analysis of infinitesimal wave motion deals mainly with forces, plane harmonic waves in a semi-infinite medium bounded by an infinite plane black wall. This analysis yields the new result that disturbances at the wall cause three distinct types of longitudinal waves to be propagated into the gas. The first wave is an acoustic wave, modified by radiation, viscosity and thermal conductivity. The second wave is induced by radiation, and the third wave is induced by viscosity and thermal conductivity. Each of these waves has been found before by means of a less general analysis than the present one, but no previous single analysis yielded all three waves. Each wave appears here in more general form, explicitly showing the combined influence of radiation, viscosity, and thermal conductivity. Analytical solutions are obtained for the speed, damping, and amplitude of all three waves. Dissert. Abstr.

N68-33591# Laboratoire d'Aerothermique Du C.N.R.S., Bellevue (France).
THEORETICAL STUDY OF FREE MOLECULAR FLOW AROUND A WIRE GRID [ETUDE THEORIQUE DE L'ECOULEMENT QUASI MOLECULAIRE LIBRE AUTOUR D'UNE GRILLE DE FILS]
Michel Gist Dec. 1967 89 p refs In FRENCH
(Rept.-67-12) CFSTI: HC $3.00/MF $0.65

A theoretical explanation is given of experimental results based on the drag of a wire grid in a low velocity-pressure discharge. The model used is a network of evenly spaced parallel wires, characterized by two Knudsen numbers, K_d and K_e, where d is the diameter of the wires and e the separation between the wires. Two assumptions are made: (1) K_d is large enough so that the flow in the vicinity of the wire is free molecular; (2) K_e is on the order of one. A distribution function for the discharge is given. An explanation of wire perturbations by the Chapman–Enskog theory leads to a solution according to the Oseen equation. Transl. by B.F.

13 GEOPHYSICS

Includes aeronomy; upper and lower atmosphere studies; oceanography; cartography; and geodesy. For related information see also: 20 Meteorology; 29 Space Radiation; and 30 Space Sciences.

N68-32273 Illinois Univ., Urbana.
EFFECTS OF SURFACE IRREGULARITIES ON THE UNDERGROUND STRESS FIELD
John Roman Sturgul (Ph.D. Thesis) 1967 121 p
Available from Univ. Microfilms: HC $6.00/MF $3.00 Order No. 67-11927

This thesis is concerned with the behavior of surface features of the earth which are, or have been, acted on by a stress field. The theory used in this thesis is that of classical elasticity. Mathematical models are made which represent perfectly elastic plates which have a notch (a protrusion can be considered as a reversed notch). The plates are assumed to be semi-infinite and the notch on the free surface. The loads, or boundary conditions, are then prescribed. The problem of determining the distribution of stress is then considered. The methods considered for solution are: 1. A classical method which is partly trial and error. 2. A complex variable method which consists of solving an integral equation. 3. A numerical method which utilizes a high speed digital computer.
Dissert. Abstr.

N68-32292 National Lending Library for Science and Technology, Boston Spa (England).
INDUCED POLARIZATION IN PROSPECTING THE DRIFT-COVERED ALTAI ORE FIELDS [METOD VYZVANNOI POLYARIZATSII PRI POISKAKH RUDNYKH POLEI ALTAYA, ZAKRYTYKH NANOSAMI]
M. V. Semenov Feb. 1968 14 p refs Transl. into ENGLISH from Akad. Nauk SSSR Sibirskoe Otd. Geol. i Geofiz. (USSR), no. 5, 1966 p 121–129
(RTS-4310) Available from Natl. Lending Library, Boston Spa, Engl.: 22s 6d

The effect of the depth and conductivity on the anomalous field of polarization induced by a vertical bed of unlimited dip and strike is estimated and data are provided on the specific electrical resistivity and polarizability of the rocks in Rudnyi Altai and on the magnitude of anomalies induced by hydrothermally altered and pyritized wall rock zones. It is concluded that it is possible to prospect very large zones under drift up to 100 meters thick or more by induced polarization and methods of field observation are suggested.
Author

N68-32308# Air Force Cambridge Research Labs., Bedford, Mass.
UV, VISIBLE, AND IR ATTENUATION FOR ALTITUDES TO 50 KM, 1968
Louis Elterman Apr. 1968 57 p *Its* Environ. Res. Papers No. 285
(AFCRL-68-0153; AD-671933)

An atmospheric attenuation model for the ultraviolet, visible, and infrared was developed in 1964, based on scattering (molecules and aerosols) and ozone absorption. Since then more measurements have been made and our knowledge of aerosol attenuation has widened. These circumstances result in attenuation model changes which are relatively unimportant for most exploratory calculations. In this paper the optical parameters are computed spectrally and with altitude as follows: (1) pure air attenuation parameters are determined by utilizing Rayleigh scattering cross sections with molecular number densities from the standard atmosphere; (2) ozone absorption parameters are derived based on Vigroux's coefficients applied to a representative atmospheric ozone distribution; (3) seven sets of aerosol measurements are compared and a profile of aerosol attenuation coefficients vs altitude is developed. Attenuation coefficients and optical thickness due to molecular, aerosol, and ozone attenuation are computed and tabulated individually so that the influence of each can be compared. The newly derived tabulations permit various exploratory calculations, including horizontal, vertical, and slat-path transmission at kilometer intervals to an altitude of 50 km, individually for each attenuating component or for overall atmospheric extinction (molecular + ozone + aerosol).
Author (TAB)

N68-32390# Kiruna Geophysical Observatory (Sweden).
A SYSTEM FOR AUTOMATIC COLLECTION AND PROCESSING OF GEOMAGNETIC DATA IN DIGITAL FORM Annual Summary Report
Georg Gustafsson and Sonia Nilsson 4 Mar. 1968 94 p refs
(Contract AF 61(052)-866)
(AFCRL-68-0259; AD-671972)

An automatic digital data recording and reduction for geomagnetic standard observations has been made. The system collects automatically all data necessary for reduction of the magnetovariograph values on punched tape, and the reduction is done by a computer which computes and prints all tables of the yearly data publication. Circuit diagrams of the equipment are given. The computer program for the reduction of the data has been included together with the tables, resulting from the reduction of the data for February 1965.
Author (TAB)

N68-32394 Florida State Univ., Tallahassee.
THE EFFECT OF HAZE UPON UMKEHR MEASUREMENTS
John James de Luisi (Ph.D. Thesis) 1967 172 p
Available Univ. Microfilms: HC $8.00/MF $3.00 Order No. 67-14450

The existence of simultaneous balloon–Umkehr data permits an experimental analysis of the influence of haze upon Umkehr curves. Both model and experimental results show that for a C-wavelength-pair Umkehr curve that has been normalized to zero at a zenith angle of 60°, the presence of haze decreases the N-values (on the average) by a maximum value of 2 at a zenith angle of 80°. From the experimental haze residual, a total average optical depth of haze particles of .30-.33 is inferred for a standard clear atmosphere over Tallahassee. Two reversals are observed in the general haze-residual curves normalized at 60°; for the C-wavelength pair a minimum occurs at about 80° and a maximum occurs at about 88°. The positions of the reversals are attributed to the way in which haze particles are distributed in the vertical.
Dissert. Abstr.

N68-32417# Ionosphären-Institut Breisach (West Germany).
IONOSPHERE DATA, VERTICAL-ECHO-SOUNDING: FREIBURG, URSI-CODE 131 [IONOSPHAEREN-DATEN, VERTIKAL-ECHO-LOTUNG: FREIBURG, URSI-CODE 131, MAI 1968]
May 1968 47 p In GERMAN and ENGLISH
(Rept.-263-F) CFSTI: HC $3.00/MF $0.65

Ionospheric data obtained at Freiburg by vertical echo sounding are presented for May 1968. Characteristics are included for the E, F1, and F2 layers, including ordinary wave critical frequencies, top frequency, and lowest usable frequency showing vertical ionospheric reflections. Symbols used are from the URSI code 131.
M.W.R.

N68-32418# Ionosphären-Institut Breisach (West Germany).
IONOSPHERE DATA, VERTICAL-ECHO-SOUNDING: FREIBURG, URSI-CODE 131, JUNE 1968 [IONOSPHAEREN-DATEN, VERTIKAL-ECHO-LOTUNG: FREIBURG, URSI-CODE 131, JUNI 1968]
Jun. 1968 48 p In GERMAN and ENGLISH
(Rept.-264-F) CFSTI: HC $3.00/MF $0.65

Ionospheric data are presented for June 1968. For abstract see N68-32417.

N68-32433# Finnish Meteorological Office, Helsinki.
MEASUREMENTS AT GEOMAGNETIC SECULAR STATIONS IN FINLAND, 1945–1967. PART 1: METHODS OF MEASUREMENT AND REDUCTION. PART 2: MEASUREMENT RESULTS
C. Sucksdorff 1968 67 p refs *Its* No. 20
CFSTI: HC$3.00/MF$0.65

An account is given of the methods used in the magnetic measurements at the Finnish secular points 1945–1967. It is shown that in the present method the main source of error is the reduction to the annual mean values. Several methods of reduction are described and compared. Since linear interpolation between two observatories has generally given as good results as the more complicated methods, it has been adopted as the standard procedure in the treatment of the results of magnetic measurements. Results of all measurements made at Finnish secular stations in 1945–1967 are presented. Author

N68-32463# Finnish Meteorological Office, Helsinki.
THE INFLUENCE OF THE BALTIC SEA AND THE GULF OF BOTHNIA ON THE WEATHER AND CLIMATE OF NORTHERN EUROPE, ESPECIALLY FINLAND, IN AUTUMN AND IN WINTER
Reijo Solantie 1968 28 p refs *Its* No. 70
CFSTI: HC$3.00/MF$0.65

The Baltic Sea proper is unfrozen throughout most winters and the Sea of Bothnia is open to traffic every other winter, with the exception of coastal waters. The Bay of Bothnia is unfrozen during at least a part of January in 80 to 90% of winters and in 40 to 50% during at least a part of February. Thus, during cold outbreaks cold air circulates over open waters. In the Bay of Bothnia, the temperature difference between the air and sea water may amount to about 10°C in early and middle winter. The flux of sensible heat from the sea to the atmosphere is proportional to wind speed and to temperature difference. It may be calculated that the flux of sensible heat has maximum values amounting to about 200 cal. cm $^{-2}(6h)^{-1}$. The consequential warming of the air over the water results in the formation of low pressure fields over these seas. The low pressure areas with warm air also effect wind, temperature, and cloud cover extending far into neighboring land areas. To investigate these effects, one situation was taken into detailed synoptic consideration. In addition to this investigation, climatological material was used to determine whether these effects are common enough to have applications in daily weather forecasting. Author

N68-32464# Emmanuel Coll., Boston, Mass. Oriental Science Library.
THE BUDGET OF THE ATMOSPHERIC RADIATION ENERGY OVER EASTERN ASIA. 3: THE HEAT BUDGET OF THE EARTH-ATMOSPHERE SYSTEM IN A CLOUDY ATMOSPHERE
Lung-Shun Chen, Chih-Pen Kung, Chia-Pin Chen, and Chung-Hsing Wang Bedford, Mass. AFCRL May 1968 29 p Transl. into ENGLISH from Ch'i Hsiang Hsueh Pao (Peking), v. 35, no. 1, 1965 p 6-17
(Contract AF 19(628)-5073)
(EMM-66-136; AD-671348)

This paper, the third part of a study on the budget of the atmospheric radiation energy over Eastern Asia, discusses three problems: (a) distribution of long-wave radiation and radiative balance in a cloudy atmosphere; (b) distribution of tropospheric heat sources and sinks over Eastern Asia; and (c) the various types of heat budget of the earth-atmosphere system over Eastern Asia. TAB

N68-32470# National Academy of Sciences National Research Council, Washington, D. C.
WAVE PARTICLE INTERACTION EXPERIMENTS
R. A. Helliwell Dec. 1967 27 p refs

Modifying the environment of the magnetosphere is discussed in terms of experiments dealing with injecting whistler-mode waves. Because the wave velocity in whistler-mode is only about 0.1c, strong interaction between waves and energetic particles is expected over a wide range of particle energy; and this interaction will modify both wave and particle characteristics. Experiments are proposed whereby interactions would be stimulated by signals transmitted from either the ground or a space vehicle. Mechanisms of whistler-mode wave propagation are treated, along with the various interaction phenomena and their interpretation. A polar-orbiting satellite and other suggested experiments are outlined and the experimental requirements are noted, particularly the lack of a suitable ground transmitter with the characteristics desired for such experiments. Satellite interfaces include up and down links as well as interference problems, the payload sizes for the outlined experiments are not as yet known, and behavior of long antennas at very low frequencies in the ionosphere must be studied. M.W.R.

N68-32471 National Lending Library for Science and Technology, Boston Spa (England).
ON THE STRUCTURE OF THE MAGNETIC FIELD OF THE EARTH [O STRUKTURE MAGNITNOGO POLYA ZEMLI]
T. N. Simonenko and E. N. Roze May 1968 18 p refs Transl. into ENGLISH from Fiz. Zemli., no. 8, 1967 p 64–73
(RTS-4475) Available from Natl. Lending Library, Boston Spa, Engl.: 25s

The results of a cross sectional analysis of the distribution of anomalies and a frequency analysis of the profile of the total intensity using the results of the aeromagnetic and marine observing network enable us to identify the principal field of the earth with the low frequency part of the spectrum of the geomagnetic field. Correlation analysis was used as a basis for the method of finding the distribution of the geomagnetic field observed along a limited profile. An estimate is given of the error of the analysis of the fields by the method of overlapping means. Author

N68-32491 National Lending Library for Science and Technology, Boston Spa (England).
INFORMATION ABOUT THE ECOLOGY OF *PHAEOCYSTIS POUCHETII* (HARIOT) LAGERHEIM, 1893 (CHRYSOPHYCEAE) IN COASTAL WATERS OF THE NORTH ATLANTIC [MATERIALY K EKOLOGII PHAEOCYSTIS POUCHETII (HARIOT) LAGERHEIM, 1893 (CHRYSOPHYCEAE) V OKRAINNYKH MORYAKH SEVERNOI ATLANTIKI]
N. I. Kashkin Oct. 1967 28 p refs Transl. into ENGLISH from Murmanskogo Morsk. Biol. Inst., v. 5, no. 9, 1964 p 16–36
(RTS-4131) Available from Natl. Lending Library, Boston Spa, Engl.: £2

The aim of this communication is to give details of certain aspects of phaeocystis ecology on the basis of investigations published up to now, of phytoplankton in the Atlantic Ocean and its seas and using material from the Murmansk Marine Biological Institute. The amount of material published was sufficient for a first attempt to be made in drawing up maps showing the distribution of the palmelloid plankton stage of phaeocystis in the coastal seas of the North Atlantic at different seasons of the year and also to reveal a relationship between phaeocystis and such factors of the abiotic medium as temperature and salinity of the sea. Author

N68-32498 National Lending Library for Science and Technology, Boston Spa (England).
MAGNETIC PROPERTIES OF TRAP ROCKS IN THE SOUTH OF THE SIBERIAN PLATFORM [REZUL'TATY ISSLEDOVANIYA MAGNITIKH SVOISTV TRAPPOV YUZHNOI CHASTI SIBIRSKOI PLATFORMY]

V. V. Metallova, I. G. Zolotov, and F. S. Fainberg Mar. 1968 15 p refs Transl. into ENGLISH from Uch. Zap. Leningr. Gos. Univ., Ser. Fiz. i Geol. Nauk (Leningrad), v. 303, no. 13, 1962 p 38–48
(RTS-4469) Available from Natl. Lending Library, Boston Spa, Engl.: 27s 6d

The experimental results obtained from study of the magnetic properties of Siberian trap rocks permit the following conclusions: 1. Under natural conditions, a close connection is observed between the character of the magnetism in the rocks and the composition of the ferromagnetic components. 2. The radial distribution of the vector of remanent magnetism in inversely magnetized trap rocks is not the consequence of remagnetization by the Earth's present field. In some cases remagnetization of particular parts of the trap bodies is observed. The direction of the vector of remanent magnetism in these parts of the rock is not subject to the general 'radial' type of distribution of the remanent magnetism as a whole. Rocks containing ilmenite as a ferromagnetic component are subject to total remagnetization. Author

N68-32498 National Lending Library for Science and Technology, Boston Spa (England).
CHEMICAL COMPOSITION OF FERRO–MANGANESE SEDIMENTS IN THE PACIFIC OCEAN [KHIMICHESKI SOSTAV ZHELEZO–MARGANTSOVYKH KONKRETSII TIKHOGO OKEANA]
N. S. Skornyakova, P. F. Andrushchenko, and L. S. Fomina Mar. 1968 31 p refs Transl. into ENGLISH from Okeanologiya (Moscow), v. 2, 1962 p 264–277
(RTS-4463) Available from Natl. Lending Library, Boston Spa, Engl.: 40s

Chemical and spectral analyses on ferro-magnetic sediments from the Pacific Ocean floor indicated a high content of manganese and iron as well as nickel, copper, lead, zirconium, tantalum, lanthanum, zinc, and a number of other elements. Manganese exceeded in tens and hundred times its content in volcanic rocks and was 10^8 to 10^9 times greater than in sea water. Concentrations of iron were also 2 to 3 times higher than in volcanic rocks and about 10^8 to 10^9 higher than in sea water. Distribution charts showed that the manganese content gradually increased from north-west towards south-east whereas the content of iron generally increased toward west and northwest. G.G.

N68-32504 National Lending Library for Science and Technology, Boston Spa (England).
JURASSIC GEOLOGY OF THE WORLD
W. J. Arkell May 1968 78 p refs Transl. into ENGLISH from the Publ. "Yurskie Otlozheniya Zemnogo Shara" p 353–386, 505–561
(RTS-4562) Available from Natl. Lending Library, Boston Spa, Engl.: 40s

Stratigraphical details of the jurassic deposits in the Crimea, Caucasus, the Georgian Mass, the Russian Platform, and the arctic region of Europe are presented. The most complete profile of jurassic deposits was established in the north-east part of the Okhotsk coast. G.G.

N68-32521# Michigan Univ., Ann Arbor. Infrared and Optical Sensor Lab.
MULTISPECTRAL SURVEY OF ARCTIC REGIONS Final Report
Robert Horvath Jan. 1968 29 p
(Contract Nonr-3996(01); DA-28-043-AMC-0013(E); Proj. Michigan)
(Rept.-1248-1-L; AD-671779)

The report describes a multispectral survey of Arctic regions conducted by the University of Michigan in the vicinity of Point Barrow during late September and early October 1967. The purpose of the effort was to obtain calibrated multispectral imagery of typical Arctic terrain and sea areas. It was envisioned that subsequent reduction and interpretation of this data would indicate the realistic potentials of multispectral remote sensing techniques as tools for scientists interested in investigating the Arctic regions of the world. Author (TAB)

N68-32526# Ballistic Research Labs., Aberdeen Proving Ground, Md.
USE OF IONIC MOBILITIES FOR MEASUREMENTS IN THE LOWER IONOSPHERE
George E. Keller May 1968 21 p refs
(BRL-1398; AD-671608)

The results of recent laboratory investigations indicate that attempts to use ionic mobilities for the identification of positive ions in the lower ionosphere must necessarily fail. A mobility determination requires ion-molecule collisions; chemical reactions occurring during these collisions will cause each mobility spectrum to tend toward a continuum. Because these reactions do not change the total number density of ions, conductivity measurements can be made using an average mobility for ions in air. Author (TAB)

N68-32537 National Lending Library for Science and Technology, Boston Spa (England).
INVESTIGATIONS INTO THE TROPOSPHERIC ABSORPTION OF RADIO WAVES BY RADIOASTRONOMICAL METHODS [ISSLEDOVANIE TROPOSFERNOGO POGLOSHCHENIYA RADIOVOLN RADIOASTRONOMICHESKIMI METODAMI]
A. G. Kislyakov and K. S. Stankevich Aug. 1968 34 p refs Transl. into ENGLISH from Izv. Vysshikh Uchebn. Zavedenii, Radiofiz. (Gorki), v. 10, no. 9, 1967 p 1244–1265
(RTS-4695) Available from Natl. Lending Library, Boston Spa, Engl.: 40s

A survey of theoretical and experimental work on atmospheric absorption of radio waves is presented. Materials discussed include: (1) the theory of molecular absorption of radio waves in the atmosphere; (2) radio frequency emission and complete atmospheric absorption; and (3) radio astronomical methods of measuring atmospheric absorption. Experimental measurements of absorption in the decimetric, centimetric, and millimetric ranges are described and compared with results of theoretical calculations. It is concluded that precise predictions of absorption levels on visible rays under various meteorological conditions are obtainable as well as predictions of the absorption coefficient of air in the surface layer and throughout most of the atmosphere. Accurate calculations of absorption at higher altitudes are still difficult to obtain. Author

N68-32542 National Lending Library for Science and Technology, Boston Spa (England).
THE IRON-MANGANESE CONCRETIONS OF THE PACIFIC OCEAN [ZHELEZO-MANGANTSEVYE KONKRETSII TIKHOGO OKEANA]
N. S. Skornyakova and P. F. Andrushchenko Jun. 1968 19 p refs Transl. into ENGLISH from Litologiia i Polezn. Iskop. (USSR), no. 5, 1964 p 21–38
(RTS-4650) Available from Natl. Lending Library, Boston Spa, Engl.: 40s

General characteristics of the iron-manganese concretions and their distribution at the bottom of the Pacific Ocean are discussed. Examples are given that show concretions occur both on the surface of the oceanic floor as well as deeper in the ocean sediments. Chemical composition of these concretions is tabulated, and maps indicate the distributions of Co, Cu, Fe, Ni, and Mn in these oceanic concretions. M.W.R.

N68-32585# Avco Corp., Lowell, Mass. Missiles, Space and Electronics Group.
ANTARCTIC RESEARCH AND DATA ANALYSIS. THE ANTARCTIC IONOSPHERE. PART B: LOWER IONOSPHERE D REGION
William H. Barber ed. Mar. 1968 94 p refs
(Contract NSF C-515)
(AVSSD-0054-68-CR; SR-29; PB-178352)

A review of pertinent knowledge about the D region over Antarctica is given with emphasis on experimental data. The large amount of data and results of relevant investigations are put into logical order, presented, and interpreted. Since precipitating electrons and energetic solar protons are the most important sources of ionization, their spectra, pitch-angle distribution, and fluxes as measured by rockets and satellites are extensively reported. This is followed by computations of the production of ion-electron pairs for such fluxes as function of altitude which indicate the importance of these sources for D-region phenomena over polar regions. Absorption of rf energy is extensively described, especially the so-called auroral absorption. There exist two main types (discrete and diffuse) which exhibit different time and latitude dependence, are connected with other atmospheric phenomena, and are caused by either splash or drizzle type precipitating electron fluxes. Conjugate events as well as polar cap absorption events and blackout are also discussed. Author (USGRDR)

N68-32668 National Lending Library for Science and Technology, Boston Spa (England).
STANDARDISATION OF VERTICAL CORRELATION ASSOCIATIONS OF TEMPERATURE OVER THE NORTHERN HEMISPHERE
O. B. Mercalova [1968] 28 p refs Transl. into ENGLISH from Tr. Nauchn.-Issled. Inst. Aeroklim. (Moscow), no. 46, 1967 p 129–148
(M-7207) Available from Natl. Lending Library, Boston Spa, Engl.

Sections of vertical temperature correlations are analyzed in an attempt to determine the extent to which established regularities in temperature distribution are common to large physico-geographical regions or to the northern hemisphere. S.C.W.

N68-32669 National Lending Library for Science and Technology, Boston Spa (England).
ON THE AEROCLIMATOLOGY OF SOUTH AMERICA
Z. I. Gavrilova [1968] 39 p refs Transl. into ENGLISH from Tr. Nauchn.-Issled. Inst. Aeroklim. (Moscow), no. 46, 1967 p 149–171
(M-7208) Available from Natl. Lending Library, Boston Spa, Engl.

Aeroclimatological data which were derived from aerological observations of South America during the IGY are given, and techniques used in the statistical processing of data from specific meteorological stations are analyzed. S.C.W.

N68-32714# Environmental Science Services Administration, Boulder, Colo. Inst. for Telecommunication Sciences and Aeronomy.
GRAM–CHARLIER SERIES DISTRIBUTION FOR IONOSPHERIC F2 LAYER CHARACTERISTICS
M. M. Siddiqui and S. M. Ostrow Sep. 1967 45 p refs
(IER-50-ITSA-49)

Analysis of foF2 and M(3000)F2 data for Washington, for the period January 1946 through July 1962, showed significant departures from normality of the monthly data distributions. The percentage of failures of the statistical test for normality was significant for all months of the year, but a striking seasonal variation in percentage of failures was noted, with peaks near the equinox periods, similar to the seasonal variation of geomagnetic disturbance. Since the assumption of normality is inappropriate, the two-term Gram–Charlier type A series is proposed as a statistical model for the monthly F2 layer data distributions. The properties of the two-term Gram–Charlier series approximation are examined and methods developed for application to ionospheric data. Examples show the application of these methods to ionospheric data distributions from Washington and other locations. Author

N68-32715# Pennsylvania State Univ., University Park. Ionosphere Research Lab.
IONOSPHERIC D-REGION ELECTRON DENSITIES AND COLLISION FREQUENCIES DURING THE QUIET SUN PERIOD MEASURED BY MEANS OF RADIO WAVE INTERACTION, PARTS 3 AND 4 Scientific Report, Jan. 1–Dec. 31, 1965
A. J. Ferraro and H. S. Lee 15 Aug. 1968 27 p refs
(Grants NSF GP-4622; NSF GP-846)
(SR-322(D))

This report presents electron density and collision frequency profiles of the D-region obtained during the IQSY Program with a radiowave interaction facility. This report covers two half-year periods from January 1, 1965 to December 31, 1965 and thus constitutes the parts III and IV of a series of reports to cover the measurement period of January 1, 1964 to December 31, 1965. All measurements have been carried out at the Ionosphere Research Laboratory (N. Lat. 40°–47', W. Long. 77°–57'), University Park, Pennsylvania. Monthly average profiles of electron density and collision frequency are presented. Preliminary results of a new high power radiowave interaction experiment are also presented and discussed. Author

N68-32752 Hawaii Univ., Honolulu.
A TWO-DIMENSIONAL, TIME DEPENDENT NUMERICAL MODEL OF ATMOSPHERIC BOUNDARY LAYER FLOW OVER INHOMOGENEOUS TERRAIN
Norman Keith Wagner (Ph.D. Thesis) 1966 106 p
Available from Univ. Microfilms: HC $5.40/MF $3.00 Order No. 67-13713

A two-dimensional, time dependent, numerical model of the atmospheric boundary layer is formulated and used to investigate various characteristics of air motion when a change occurs in the roughness of the underlying surface. The model assumes a dry adiabatic atmosphere with adiabatic changes of state, no dynamic pressure effects due to flow accelerations and no vertical displacement of the zero-velocity level at the lower boundary when a discontinuity in surface roughness is encountered. Numerical evaluation of all terms in the resulting equations shows very little change in the computed fields of velocity if an incompressible atmosphere is assumed and horizontal mixing is neglected. A computational stability analysis is made which provides the relationship between time-step and grid spacing necessary to insure convergence of the numerical solution. Dissert. Abstr.

N68-32765 National Lending Library for Science and Technology, Boston Spa (England).
MEASUREMENT OF SLANT VISIBILITY BY THE METHOD OF EQUAL ANGLES
V. A. Markelov 14 Apr. 1966 7 p refs Transl. into ENGLISH from Glav. Uprav. Gidromet. Sluz. Met. Gidr. (Leningrad), no. 4, 1967 p 63–67 In ENGLISH and RUSSIAN
(M-7364) Available from Natl. Lending Library, Boston Spa, Engl.

An equal angle method of measuring slant visibility is derived based on the theory that the transmissivity of any medium, including the atmosphere, may be described by a coefficient of directional penetration equal to the ratio of the radian flux passing through a given layer of atmosphere to the flux which leaves the layer in the given direction. It is stated that the equal angle method is appropriate when there is zero gradient of horizontal transmissivity or where it is constant horizontally and changes only in the vertical. B.S.D.

N68-32773# RAND Corp., Santa Monica, Calif.
CLIMATIC CHANGE AND ICE EXTENT ON THE SEA
J. O. Fletcher Apr. 1968 23 p refs Presented at the Natl. Conf. on Weather Modification, Albany, 28 Apr.–1 May 1968
(Contract NSF-C-415)
(P-3831, PB-178502) CFSTI: HC $3.00/MF $0.65

Quantitative assessments of the annual variations of the Arctic and Antarctic heat budgets are related to annual variations in general circulation of the atmosphere. Large long-term heat budget variations also occur in both polar regions and are closely related to the variable extent of ice on the sea. Quantitative estimates of these long-term variations in the intensity of the polar heat sinks are presented and their possible significance for explaining changes in global climate is discussed.
Author (USGRDR)

N68-32774# Lincoln Lab., Mass. Inst. of Tech., Cambridge.
INVESTIGATION OF LONG PERIOD NOISE AT LASA
Jack Capon 3 Jun. 1968 65 p refs
(Contract AF 19(628)-5167; ARPA Order 512)
(ESD-TR-68-176; TN-1968-15; AD-671509)

The long-period noise in the 20 to 40 second period range limits the identification level at which the surface-wave, body-wave discriminant can be applied at the Large Aperture Seismic Array (LASA). Therefore, an investigation was made to determine the sources and properties of this noise. Only the long-period vertical array at LASA was considered. Both conventional and high-resolution frequency-wavenumber spectra are presented for the noise, as well as coherence results. These data show that the noise consists of two components. One component propagates across the array as fundamental-mode Rayleigh waves and is known to be caused by the action of surf on coastlines. The other component is nonpropagating and evidence is presented which indicates it is caused by the elastic loading on the ground by the earths atmosphere. This is established by correlating the power of the nonpropagating noise with the power on the microbarograph sensors at LASA. It is also shown that the signal-to-noise ratio gain obtained with maximum-likelihood processing relative to that obtained with beamforming for the long-period noise present at LASA, will not be substantial unless it can be shown that significant amounts of propagating noise power, relative to total noise power, are present. The results at LASA indicate that such large amounts of propagating noise power are rarely to be observed.
Author (TAB)

N68-32819# Massachusetts Inst. of Tech., Cambridge. Fluid Mechanics Lab.
A POINT EXPLOSION IN A COLD EXPONENTIAL ATMOSPHERE
Dallas D. Laumbach and Ronald F. Probstein May 1968 52 p refs Supported by ARPA
(Contract Nonr-1841(93))
(FUBL-68-3; AD-671931)

The problem considered is that of a strong shock propagating from a point energy source into a cold atmosphere whose density varies exponentially with altitude. An explicit analytic solution is obtained by taking the flow field as locally radial and using an integral method with an energy constraint. A scaling law is given which eliminates the parametric dependence of the solution on the explosion energy, scale height, and atmospheric density at the point of the explosion. The scaling law also transforms the infinity of solutions for various polar angles into two distinct solutions which show that all motions of the ascending portion of the shock may be scaled from the vertically upward behavior and all motions of the descending portion of the shock may be scaled from the vertically downward behavior. The limit in the lateral direction of both of the fundamental solutions corresponds to the case of the uniform density atmosphere. Comparison with finite difference calculations shows excellent agreement. The empirical concept of modified Sachs scaling for calculating the overpressure is considered and shown within this model to have a justification in the downward direction but a limited range of applicability in the upward direction.
Author (TAB)

N68-32907*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
PARAMETRIC ANGLES OF TRAJECTORY DETERMINED FIELD LINE INTERSECTS
E. G. Stassinopoulos Jul. 1968 34 p refs
(NASA-TM-X-63312; X-642-68-310) CFSTI: HC $3.00/MF $0.65 CSCL 04A

Geomagnetic field lines are traced from points on a ballistic trajectory to the points where they cross a given altitude shell. The intersects thus obtained are called "trajectory determined intersects." Three parametric angles identify and describe their positions: the look-angles ψ and ϵ, azimuth and elevation respectively, which relate and intersect to a fixed location on the earth; and the line-angle α, which for an observer stationed at this fixed location is a measure of the divergence of the line-of-sight from the field line. The locus of all trajectory-determined intersects is the "intersect trace" at the specified altitude level. The intersect trace of a sample rocket trajectory is obtained for the 100 kilometer level. The variations of the parametric angles with time and altitude are calculated for 19 ground locations distributed symmetrically around the launch site. For the specific flight path considered, there exists an area of the earth where optimum parametric angle conditions prevail, i.e., minimum changes in ψ and ϵ, and smallest values of α.
Author

N68-32910# Air Weather Service, Scott AFB, Ill.
FINITE-DIFFERENCE METHODS USED IN MODELS OF THE ATMOSPHERIC BOUNDARY LAYER
Lynn L. Leblanc Jun. 1968 18 p refs
(AWS-TR-206; AD-671935)

Several finite-difference methods for solving the equations considered in modeling the planetary boundary layer and some new techniques for the use of these methods are presented and commented on. Three implicit finite-difference schemes and one explicit scheme are discussed as each is considered in view of required computer running time.
Author (TAB)

N68-32936# Environmental Science Services Administration, Boulder, Colo. Inst. for Telecommunication Sciences and Aeronomy.
A COMPARISON OF SUDDEN IONOSPHERIC FREQUENCY DEVIATIONS WITH SOLAR X-RAY AND CENTIMETERWAVE EMISSION DURING OCTOBER 1963
Donald M. Baker Sep. 1967 45 p refs
(ARPA ORDER 183)
(IER-43-ITSA-43)

A simple model is developed which permits us to calculate the sudden ionospheric frequency deviation which would be caused by a known solar X-ray burst, or vice-versa, to calculate the time profile of the X-ray burst responsible for an observed frequency deviation. This model is also used to compare the frequency deviations observed during six solar flares with the time profiles of the solar emissions at centimeter and X-ray (0.5-10 Å) wavelengths which accompanied the flares. Better time and spectral resolution are needed in order to permit a detailed comparison of the variations in the X-ray flux with the ionospherically induced frequency deviations.
Author

N68-32985# Navy Electronics Lab., San Diego, Calif. Center for Command Control and Communications.
LIGHTNING DISCHARGE CHARACTERISTICS DETERMINED FROM EXTREMELY LOW-FREQUENCY ATMOSPHERICS Research Report, Jul. 1967–Feb. 1968

H. G. Hughes 29 Feb. 1968 23 p refs
(NELC-1540; AD-671998)

The physical description of a median lightning flash is of practical interest in the statistical evaluation of the global electromagnetic noise spectrum and its effects upon communication systems. A technique for locating and investigating the fine structure of individual lightning discharges occurring several thousands of kilometers from a single receiving station is described. The method employs the simultaneous measurement of the vertical and horizontal components of slow tail atmospheric waveforms. Particular example of slow tail waveforms with different characteristics received from lightning discharges occurring simultaneously in widely separated localities are presented. The mean amplitude spectra of the waveforms emanating from the two storm areas are used to calculate the mean source current moment spectra of the waveform sources using zero-order mode theory. The calculated spectra are then compared with data of other workers who employed different measurement techniques. Plans for future measurements necessary to refine the technique are also discussed. Author (TAB)

N68-33044 Washington Univ., Seattle.
THE INFLUENCE OF ENVIRONMENTAL PARAMETERS ON THE FREEZING AND FRAGMENTATION OF SUSPENDED WATER DROPS
James Eugene Dye 1967 121 p
Available from Univ. Microfilms: HC $6.00/MF $3.00 Order No. 67-14168

In this thesis the various factors that might influence the fragmentation of freezing drops are discussed and where possible analyzed in detail. These include the composition and pressure of the environmental gas, the condition of the drop prior to nucleation, the nucleation temperature, the rate of freezing, the formation of gas bubbles inside the drop, and the ventilation of the drop. Drops falling in the atmosphere are shown to be near thermal and solution equilibrium. The heat balance of a freezing drop is analyzed theoretically, and the rate of heat loss is computed for a 1 mm diameter drop falling and freezing in air at −10C and a pressure of 1 atm, and for 1 mm diameter drops suspended and freezing at −10C in air, helium, hydrogen and carbon dioxide at 1 atm and air at 0.1 atm. The symmetricalness of freezing with respect to the center of the drop is discussed for these cases. Due to the complex interaction of the environmental parameters it has not been possible to determine from theoretical considerations alone the conditions under which a drop is most likely to fragment. Dissert Abstr.

N68-33048 National Lending Library for Science and Technology, Boston Spa (England).
ERRORS IN THE EOS OF THE SibIZMIR AND KrAO MAGNETOGRAPHS [POGRESHNOSTI EOM MAGNITOGRAFOV SIBIZMIR I KRAO]
G. V. Kuklin Feb. 1968 9 p Transl. into ENGLISH from Resul'taty Nablyudenii i Issled. v Period MGSS, no. 1, 1966 p 118–123
(RTS-4352) Available from Natl. Lending Library, Boston Spa, Engl.: 12s 6d

Formulas are derived for evaluating the error signals which occur during the recording of the longitudinal field component by an circular polarization modulator (EOM) and the recording of the transverse field components by an ordinary linear polarization modulator (EOS). In both cases, the recording is made at the first harmonic. An approximation method is used for the calculations. A method is also proposed for evaluating the errors in recording the radial velocities. Tabulated data are included to show the effect of individual errors on the measurements of various quantities. It is shown that the greatest effect is due to errors in making the λ/4 plates. M.G.J.

N68-33130*# Texas A&M Univ., College Station. Oceanography Dept.
PRELIMINARY RESULTS FROM CONVAIR 240A MISSION 50, 12 JUNE 1967, OVER MISSISSIPPI DELTA AREA
Preliminary Report
Jack F. Paris 3 May 1968 43 p refs Sponsored in part by NASA /ts Ref. No. 68-6T
(Contract Nonr-2119(04))
(NASA-CR-96238; AD-669810) CFSTI: HC $3.00/MF $0.65 CSCL 08C

On June 12, 1967, Test Site 128 (Mississippi Delta) was overflown on three flights by the NASA Convair 240A aircraft equipped with multispectral sensors as a part of Mission 50. The data obtained was studied to determine its quality and scientific value. Twenty-seven percent of the color photography taken by the RC-8 metric camera was judged to be useful. Many potentially useful photographs were lost due to untimely film changes. The sediment-boundary could easily be seen in the RC-8 photography. Author (TAB)

N68-33197*# Michigan Univ., Ann Arbor. High Altitude Engineering Lab.
IONOSPHERIC COMPOSITION MEASUREMENTS WITH AN RF IMPEDANCE PROBE
E. K. Miller and H. F. Schulte, Jr. May 1968 56 p refs
(Contract NASR-54(05); Proj ORA 05627)
(NASA-CR-96373; Rept.-05627-20-T) CFSTI: HC $3.00/MF $0.65 CSCL 04A

Consideration is given to extending various methods used for determining electron number density in the ionosphere to ion composition measurements. A technique involving the impedance of an antenna operated in a frequency range on the order of the ion cyclotron frequency to the electron cyclotron frequency appears promising. Theoretical impedance results for some idealized combinations of ions as well as typical ion mixtures encountered in the ionosphere illustrate application of the technique. The advantages and limitations of the impedance probe are discussed. Author

N68-33198*# Michigan Univ., Ann Arbor. High Altitude Engineering Lab.
IONOSPHERIC CHARACTERISTICS FROM ALTITUDE VARIATIONS OF POSITIVE ION DENSITIES AT NIGHT
Scientific Report
S. N. Ghosh Mar. 1968 23 p refs
(Contract NASr-54(05); Proj. ORA 05627)
(NASA-CR-96379; Rept.-05627-16-S) CFSTI: HC $3.00/MF $0.65 CSCL 04A

Altitude variations of different types of positive ions in the ionosphere at night obtained from rocketborne experiments, have been utilized to obtain ionospheric characteristics. Major nighttime ionic processes and rate coefficients of certain reactions involving positive ion–neutral atoms or molecules are obtained. Lifetimes and effective recombination coefficients of positive ions at night are also obtained. It was further shown that at night the ionosphere is not in equilibrium. Only at localized regions, there is equilibrium between the production and loss rates. Author

N68-33208*# National Aeronautics and Space Administration Goddard Space Flight Center, Greenbelt, Md.
THE LATITUDINAL TEMPERATURE STRUCTURE OF THE TOPSIDE IONOSPHERE
H. G. Mayr, L. H. Brace, and W. Crevier Jun. 1968 22 p refs
(NASA-TM-X-63305; X-621-68-233) CFSTI: HC $3.00/MF $0.65 CSCL 04A

By solving the energy and continuity equations for O^+ and H^+, the observed latitudinal electron temperature distribution

observed by Explorer XXII can be reproduced up to latitudes of 60° with a trough at the equator and maxima at middle latitudes. At geomagnetic latitudes above 60°, however, the theoretical temperatures decrease significantly below the observed temperatures. It is suggested that the depletion of H+ observed at high latitudes by ion mass spectrometers could be related. Such a depletion of the light ion population causes the electron cooling rate to the neutral atmosphere, to decrease; an effect that would enhance the temperature. Author

N68-33229*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
SOUNDING ROCKET MEASUREMENTS OF ION COMPOSITION AND CHARGED PARTICLE TEMPERATURES IN THE TOPSIDE IONOSPHERE
E. J. R. Maier Aug. 1968 26 p refs
(NASA-TM-X-63315; X-615-68-316) CFSTI: HC $3.00/MF $0.65 CSCL 04A

The concentrations of H+, He+, and (O++N+) were measured as a function of altitude from 300 km to 600 km by means of an ion mass spectrometer. The major constituent was found to be O+ over the entire altitude range, decreasing from >99% of the total ion density at 300 km to 88% at 600 km. Hydrogen and helium ions were present as minor constituents increasing with altitude to 11% and ~1% respectively at 600 km. At the same time, the electron and total ion densities and temperature were measured and compared by means of retarding potential analyzers. The ion temperature was found to increase with an altitude gradient of 1.7°/km from 1100° at 300 km to 1600° at 600 km. Electron temperatures were found to increase rather sharply in the 400 to 500 km altitude from the fairly typical value of 2500° to the very high value of 3500° at 600 km. Author

N68-33232# Naval Oceanographic Office, Washington, D. C.
INVESTIGATION OF RELATIONSHIP BETWEEN THE FIELD OF ATMOSPHERIC PRESSURE AND CURRENTS IN THE GULF OF FINLAND [ISSLEDOVANIYE SVYAZI MEZHDU POLEM ATMOSFERNOGO DAVLENIYA I TECHENIYAMI V FINSKOM ZALIVE]
Yu. D. Mikhaylov and M. A. Babanina 1968 10 p refs Transl. into ENGLISH from Tr. Gos. Okeanogr. Inst. (Leningrad), v. 87, 1965 p 58–63
(NOO-TRANS-384; AD-671860)

The study is an attempt to utilize the expansion of pressure fields into a series of Chebyshev polynomial with a view to establishing prognostic ratios to currents. The results of multiple correlation of elementary pressure fields to currents for various periods in advance are listed. The calculated currents are compared with the observed currents. Author (TAB)

N68-33243*# Woods Hole Oceanographic Institution, Mass.
MOLECULAR COMPOSITION OF NITROGENEOUS COMPOUNDS IN SEA WATER AND RECENT MARINE SEDIMENTS
Egon T. Degens Aug. 1968 31 p refs Presented at the Symp. on Org. Matter and Nat. Water, Fairbanks, Alaska, 2 Sep. 1968
(Contract NSR-22-014-001)
(NASA-CR-96378; WHOI-68-52) CFSTI: $3.00 CSCL 08J

Data and concepts on the molecular composition of nitrogeneous organic matter in sea water and sediments are presented. Proteins and protein-derived metabolites, such as urea and amino acids, account for the bulk of the dissolved organic matter in the sea; the low C/N ratio with a mean of 2.5 to 3.0 supports this inference. These compounds, however, do not occur in the free state primarily, but they are combined, e.g., in clathrate-type complexes. The particulate organic matter in surface waters is largely represented by living organisms and in deep waters by intact or partially degraded biogenic material. Detritus and dissolved organic matter supplied to the sediments are used for de novo synthesis of proteins by microorganisms and burrowing animals. Polymerization may also be achieved via epitaxial growth on mineral surfaces. In oxidizing environments, nitrogeneous compounds are diagenetically degraded rather rapidly unless they are protected by minerals such as organic clay derivatives or shell carbonates. In contrast, strongly reducing environments do favor the preservation of organic matter as a consequence of low biological activity. The latter circumstances may even lead to a redistribution and separation of distinct organic molecules via natural chromatography. Author

N68-33267*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
THE DYNAMIC COUPLING BETWEEN F2-REGION AND PROTONOSPHERE
H. G. Mayr Jul. 1968 22 p refs
(NASA-TM-X-63310; X-621-68-300) CFSTI: HC $3.00/MF $0.65 CSCL 04A

The time dependent continuity equations for H+ and O+ are solved by means of a perturbation method. A solution for the diurnal variation of these ion species is presented to illustrate the dynamic effects of the coupling between F2-region and protonosphere. The variability of the ion composition transition level is discussed in view of the observed ion trough at high latitudes, and from this, evidence is found for a continuous depletion of protons there. Author

N68-33272*# Douglas Aircraft Co., Inc., Santa Monica, Calif. Missile and Space Systems Div.
THE ROLES OF KINETIC THEORY AND GAS-SURFACE INTERACTIONS IN MEASUREMENTS OF UPPER-ATMOSPHERIC DENSITY
Mildred M. Moe (Loyola Univ., Los Angeles), and Kenneth Moe Jul. 1968 10 p refs Sponsored in part by NASA
(NASA-CR-96311; Douglas Paper-5064) CFSTI: HC $3.00/MF $0.65 CSCL 04A

The roles played by kinetic theory and gas–surface interactions in the interpretation of measurements made by mass spectrometers, pressure gauges, and satellite drag are discussed. The effect of adsorption is analyzed in detail. A resolution of the discrepancies between drag and instrumental measurements is proposed, taking into account the corrections for adsorption, gauge calibration, and chemical reactions of atomic oxygen. Author

N68-33301* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
A COMPUTER PROGRAM FOR ELECTRON PROBE MICROANALYSIS IN THE FIELDS OF METALLURGY AND GEOLOGY
Joseph I. Goldstein [1968] 3 p refs Presented at the 3rd Natl. Conf. on Electron Probe Microprobe Anal., Chicago, 31 Jul.–2 Aug. 1968
(NASA-TM-X-61157) CFSTI: $3.00 CSCL 08G

Mention is made of a comprehensive computer program written in Fortran and useable in time sharing mode that can be used for electron probe microanalyses in metallurgy and geology. The program consists of a large number of subroutines that can be easily changed as the user sees fit or as new correction schemes become available. Both K and L X-radiations are considered and the program can operate in either of two modes: (1) conversion of raw intensity data to composition using iterative procedure of (2) conversion of compositional data to expected X-ray intensities. Details of the program or the corrections are not included in this note. M.W.R.

N68-33345 National Lending Library for Science and Technology, Boston Spa (England).

ON ONE INTERESTING MANIFESTATION OF HALE'S CYCLE IN THE EARTH'S ATMOSPHERIC CIRCULATION

R. V. Abramov [1968] 9 p refs Transl. into ENGLISH from Geomagnetizm i Aeronomiya (Moscow), no. 7, 1967 p 561–563 In RUSSIAN and ENGLISH

(M-7123) Available from Natl. Lending Library, Boston Spa, Engl.

Changes in the geographical position and intensity of the Icelandic minimum in atmospheric pressure and changes in solar activity which occurred during the period 1898 to 1957 are assessed in an attempt to determine the influence of solar activity on the general circulation of the earth's atmosphere. For the period considered, long period changes in solar activity and in the characteristics of the Icelandic minimum were in general agreement; however, it was observed that: (1) the relationships discovered were statistically significant only when smoothed values were compared, and (2) fluctuations of the natural series lead to the disappearance of the relationship between longitudinal migrations of the center of the Icelandic minimum and Wolf numbers expressing the level of solar activity. On the basis of results of measurements made on Lunik-1, Lunik-2, and Explorer-XII, it is surmised that the alternation of large and small seasonal migrations of the Icelandic minimum along a line of longitude, when there is alternation in the 11-year cycles of solar activity, is influenced by factors connected with periodic changes in the magnetic polarity of the sun while the polarity of the geomagnetic and interplanetary magnetic field remains constant. S.C.W.

N68-33347 National Lending Library for Science and Technology, Boston Spa (England).

ON THE NATURAL RESIDUAL MAGNETIZATION OF THE ROCKS [O YESTESTVENNOY OSTATOCHNOY NAMAGNICHENNOSTI GORNYKH POROD]

A. A. Smelov, L. P. Zhogolev, and R. I. Khabibulina Apr. 1968 21 p refs Transl. into ENGLISH from Uch. Zap. Vopr. Geofiz. Leningrad Univ. (USSR), v. 303, 1962 p 245–266

(RTS-4470) Available from Natl. Lending Library, Boston Spa, Engl.: 40s

Results of studies of the characteristics of natural residual magnetization of rocks in the Central Kazakhstan, and geological-mineorological characteristics of the reversely magnetized rocks in other regions of the Earth's crust, particularly the Angoro-Ilimsk iron ore deposits; are presented. Analyzed are (1) the relationship between the type (positive or negative) of magnetization in rocks and ore fraction composition; (2) the relationship between the type of natural residual magnetization of rocks and the conditions of their formation; (3) the relationship between residual magnetization and magnetic susceptibility; and (4) the relationship between the direction of natural residual magnetization and rock joining. Arguments are presented which support the hypothesis of the self-reversibility of the natural, residual magnetization of rocks, and which reject the hypothesis of the rotation of the Earth's magnetic field and the migration of the poles. The significance of results in explaining the tectonics of intrusive bodies is also discussed. S.C.W.

N68-33398# Laboratoires d'Electronique et de Physique Appliqué, Limeil-Brevannes (France).

FUNDAMENTAL ASPECTS OF OBSERVATION OF TERRESTIAL GROUND BY INFRARED PASSIVE TELEVISION FROM A SATELLITE [ASPECTS FONDAMENTAUX DE L' OBSERVATION DU SOL TERRESTRE PAR TELEVISION INFRAROUGE PASSIVE A PARTIR D' UN SATELLITE]

F. Desvignes *In* AGARD Advanced Tech. for Aerospace Surveillance 1968 p 85–116 refs In FRENCH (See N68-33392 20-14)

The following research is summarized: (1) a detailed survey of the emissive properties of most of the materials concerned such as soil, rocks, trees, building materials, paints, metals, and their spectral distribution; (2) an analysis of the thermal balance of ground, building, plants, taking into account diurnal and seasonal variations; (3) an examination of problems due to atmospheric absorption, emission and diffusion; (4) the calculation of the information capacity of the infrared signals received by a given equipment in the satellite versus the main characteristics of the equipment; (5) a survey of operational detectors, compared with theoretical limits taking into account technological problems in order to look for future possible improvements. From these results, practical limits for temperature, space and time resolution are given. Technological problems that are as yet unsolved are indicated. Author

N68-33399# Compagnie Generale de Telegraphie Sans Fil, Orsay (France).

GROUND CARTOGRAPHY BY AN AIRBORNE HERTZIAN RADIOMETER [CARTOGRAPHIE DU SOL PAR RADIOMETRE HERTZIEN AEROPORTE]

B. Richard and J. P. Peltier *In* AGARD Advanced Tech. for Aerospace Surveillance 1968 p 117–132 refs In FRENCH (See N68-33392 20-14)

The effects of atmospheric conditions on wavelengths is discussed in terms of instruments for absorption measurements. The instrumentation described functions to 8 mm wavelength; separation is 1", and the observed field is ±25'. The aerial is connected to the frequency tube with waves ranging from weak to large passbands. The radiometer was installed on a B-26 aircraft. The initial results are compared with other optical and infrared procedures. Transl. by M.G.J.

N68-33400# Deutsche Versuchsanstalt fur Luft- und Raumfahrt, Oberpfaffenhofen (West Germany). Institut fuer Flugfunk und Mikrowellen.

SOME RESULTS OF PASSIVE MICROWAVE GROUNDMAPPINGS

F. Schlude *In* AGARD Advanced Tech. for Aerospace Surveillance 1968 p 133–148 refs (See N68-33392 20-14)

A 35 GHz radiometer has been used for mapping selected areas with characteristic water-land contrasts by line-scanning the antenna and by flying a parallel strip flight programme. The report of this work begins with a short discussion of basic passive microwave mapping problems. Then the equipment of the airborne part of the mapping system, its calibration and the data processing on the ground are described in detail. As a result of the flight experiments four thermal maps are shown of different targets, indicating the resolution capability of the mapping system with reference both to larger lakes and to an accumulation of many small lakes. Author

N68-33416*# National Aeronautics and Space Administration Flight Research Center, Edwards, Calif.

ATMOSPHERIC CONDITIONS ASSOCIATED WITH TURBULENCE ENCOUNTERED BY THE XB-70 AIRPLANE ABOVE 40,000 FEET ALTITUDE

L. J. Ehernberger Washington Sep. 1968 49 p refs

(NASA-TN-D-4768) CFSTI: HC $3.00/MF $0.65 CSCL 04B

High-altitude atmospheric turbulence has been encountered by the XB-70 airplane during flight test over the Western United States. The encounters from 36 flights were analyzed for the meteorological features associated with high-altitude turbulence. This study used data from an NACA VGH recorder carried on the airplane and from rawinsonde observations made near turbulence encounters at altitudes above 40,000 feet (12,200 meters). These data showed that turbulence of significant intensity at high altitudes is related to wind velocity, vertical wind shear, and the vertical temperature gradient. It is also indicated that the disturbances causing high-altitude turbulence can originate in both the lower atmosphere and the stratosphere. Author

N68-33439* Volt Technical Corp., Washington, D. C.
INTERPRETATION OF GEOMAGNETIC Pc3, 4 PULSATIONS [INTERPRETATSIYA GEOMAGNITNYKH PUL'SATSIY Pc3, 4]
B. E. Bryunelli, A. M. Lyatskaya, and V. B. Lyatskiy Greenbelt, Md. NASA. Goddard Space Flight Center 19 Aug. 1968 6 p refs Transl. into ENGLISH from Geomagnetizm i Aeronomiya (Moscow), v. 8, no. 3, 1968 p 540–544
(Contract NAS5-12487)
(NASA-CR-96273; ST-GM-10743) CFSTI: $3.00 CSCL 04A

Discussed in this paper are the possible Alfven resonances in sections of tubes of force bounded on one side by the weak field region in the neighborhood of neutral points at magnetosphere boundary and on the other side by the earth's surface. It is shown that if resonance excitation on the fundamental harmonic is more probable in the tubes of force closest to neutral points, resonances on the second harmonic may result more effectively with the transition to deeper layers of the magnetosphere. The resonance of the fundamental harmonic is identified with the Pc4 pulsations, while the one on the second harmonic is identified with Pc3.
Author

N68-33511*# Ohio State Univ. Research Foundation, Columbus. Dept. of Geodetic Science.
DATA ANALYSIS IN CONNECTION WITH THE NATIONAL GEODETIC SATELLITE PROGRAM (2) Semiannual Status Report, Feb.–Jul. 1968
Aug. 1968 35 p
(Grant NGR-36-008-093)
(NASA-CR-96452; SASR-2) CFSTI: HC $3.00/MF $0.65 CSCL 08E

In order to fulfill the primary objective of the geometric analysis of geodetic satellite data, the following tasks were undertaken during the period covered. (1) Extension of the computer programs which can handle optical and/or range observations for range and range rate, Doppler, and laser systems. (2) Development of data preprocessing systems to handle the data from the above observation methods. (3) Analysis of observational data for the National Geodetic Satellite Program for the purpose of fulfilling the primary objective as observational data becomes available. (4) The development of computer programs for the adjustment of optical, ranging and Doppler data in the short-arc mode. (5) Theoretical investigations into sequential least squares adjustment of simultaneous satellite observations in combination with terrestrial data.
Author

N68-33526*# Douglas Aircraft Co., Inc., Santa Monica, Calif. Missile and Space Systems Div.
A NEW METHOD OF DETERMINING THE MEAN MOLECULAR MASS
K. Moe May 1968 7 p refs Presented at 3rd Natl. Conf. on Aerospace Meteorology, New Orleans, 6–9 May 1968
(Contract NAS5-9324)
(NASA-CR-96355; Douglas Paper-4820) CFSTI: HC $3.00/MF $0.65 CSCL 04A

A method for determining the mean molecular mass in the upper atmosphere is presented. The method reduces the errors which are caused mainly by absorption cross section extinction measurements, calibration processes, and recombination. In the new method the density scale height and the vertical gradient of the pressure scale height are measured by means of the orbital decay of conventional satellites and the spin decay of paddlewheel satellites in highly eccentric orbits. These quantities are inserted in the equation $H\rho = H/(1+\delta)$ to obtain the pressure scale height. Temperatures measured by several different methods are used with the pressure scale height to deduce the mean molecular mass.
C.T.C.

N68-33549*# Chicago Univ., Ill. Enrico Fermi Inst. for Nuclear Studies.
AGES OF CA-RICH ACHONDRITES
D. Heymann, E. Mazor, and E. Anders [1968] 27 p refs Presented at I.A.E.A. Conf. on Meteorites, Vienna, 7–13 Aug. 1968 Prepared jointly with Rice Univ.
(Grants NsG-386; NGR-44-006-041; Contract AT(11-1)-382)
(NASA-CR-96361; SM-109/70) CFSTI: HC $3.00/MF $0.65 CSCL 08D

Inert gas contents were measured in 27 of 30 meteorites classified as eucrites and shergottites in order to increase knowledge on the ages of the Ca-rich achondrites. Observed radiation age distribution was found to be rather flat to approximately 30 Myr; and, as is the case for most other classes of stony meteorites, no ages above 70 Myr were found. The fact that the lunar distribution has 81% of its ages in the less than 10 Myr interval is not considered a strong argument against a lunar origin for these meteorites if one assumes that only a few minor impacts occurred on the moon in the last 10 Myr. The gas retention ages seem to imply (1) burial beneath the lunar surface to allow for loss of helium 4, (2) transport to the surface mainly during the last two Gyr, or (3) ejection in another impact. The asteroidal origin would imply (1) reheating by impact followed by relatively slow cooling and (2) ejection in another, more recent impact. These data do not favor either hypothesis on the origin of the Ca-rich achondrites. Lunar evidence, substantiated by the predominance of morning falls among eucrites, can be reconciled with radiation age distrubution. The existence of mesosiderites and unbrecciated eucrites, on the other hand, seems to favor as asteroidal origin.
M.W.R.

N68-33560*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
MAGNETOSPHERIC CONVECTION PATTERNS INFERRED FROM HIGH LATITUDE ACTIVITY
J. P. Heppner Aug. 1968 28 p refs Presented at the Aurora and Airglow, 1968 Advanced Study Inst., As, Norway, 29 Jul.–9 Aug. 1968
(NASA-TM-X-63317; X-612-68-331) CFSTI: $3.00 CSCL 04A

Magnetospheric convection is discussed in terms of the information provided and restrictions imposed by the distribution of ionospheric currents at high latitudes. Convection models are included, and the current pattern from magnetic disturbance plots is discussed along with the convective boundary from the OV-10 satellite and the magnetospheric convection pattern. Convection implications of the disturbance pattern are also considered, including relating the plasmapause to convection, solar wind and the electric field as the driving field for magnetospheric convection, convection patterns during quiet times, and mid-day auroral belt convection. Some reservations regarding convective models are noted, including the fact that the present paper considered only large scale features of the convection pattern.
M.W.R.

N68-33569# Joint Publications Research Service, Washington, D. C.
PROPAGATION AND ABSORPTION OF RADIO WAVES IN THE ATMOSPHERE AND TROPOSPHERE
28 Aug. 1968 64 p Transl. into ENGLISH from Izv. Vyssh. Uchebn. Zaved., Radiofiz. (Gor'kiy), v. 10, no. 9–10, 1967 p 1213–1243
(JPRS-46311) CFSTI: HC $3.00/MF $0.65

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2. A STUDY OF TROPOSPHERIC ABSORPTION OF RADIO WAVES BY RADIO ASTRONOMY METHODS A. G. Kislyakov and K. S. Stankevich p 38–62 (See N68-33571 20-13)

N68-33570# Joint Publications Research Service, Washington, D. C.
PROPAGATION OF CENTIMETER, MILLIMETER AND SUBMILLIMETER RADIO WAVES IN THE EARTH'S ATMOSPHERE
S. A. Zhevakin and A. P. Naumov *In its* Propagation and Absorption of Radio Waves in the Atmosphere and Troposphere 28 Aug. 1968 p 1–35 (See N68-33569 20-13)

Studies dealing with microwave radio propagation in the atmosphere and transparency with spectral resolution are reviewed. General problems of molecular absorption in the atmosphere are reviewed for centimeter, millimeter, and submillimeter waves; and absorption of microradio waves by monomers and dimers of water vapor in the atmosphere is considered. In both instances theoretical computations of absorption coefficients are presented. The five procedures currently used to experimentally determine the absorption coefficient of water vapor in the atmosphere are given, and a comparison is offered of experimental and calculated values of these coefficients. Attention is given to the literature dealing with the absorption of microwaves by molecular oxygen, and the incompleteness of such data is noted. The microradio wave refraction coefficient in the earth's atmosphere is considered, and some determinations from the literature are reported. Problems related to millimeter and submillimeter radiowave propagation are noted in general terms. M. W. R.

N68-33571# Joint Publication Research Service, Washington, D. C.
A STUDY OF TROPOSPHERIC ABSORPTION OF RADIO WAVES BY RADIO ASTRONOMY METHODS
A. G. Kislyakov and K. S. Stankevich *In its* Propagation and Absorption of Radio Waves in the Atmosphere and Troposphere 28 Aug. 1968 p 36–62 (See N68-33569 20-13)

An overview is presented of the contemporary state-of-the-art relating to the molecular absorption of radio waves and measurements by radio astronomy methods. Theoretical aspects of such absorption in the atmosphere are discussed, and numerous methods for calculating absorption spectra are included. Tables summarize various results for the absorption of radio waves in atmospheric oxygen and in water vapor, and comparison is made between experimental and theoretical findings. M.W.R.

N68-33574 National Lending Library for Science and Technology, Boston Spa (England).
ON THE INFLUENCE OF THE 11-YEAR CYCLE OF SOLAR ACTIVITY ON THE ATMOSPHERIC CIRCULATION
V. A. Beljazo [1968] 15 p refs Transl. into ENGLISH from Probl. Arktiki i Antarktiki (Leningrad), no. 26, 1967 p 29–34
(M-7116) Available from Natl. Lending Library, Boston Spa, Engl.

The distribution of circulation types in the phases of the 11-year cycle were investigated. It was found that each phase of the cycle has its own perculiarities in the monthly distribution of anomalies in the circulation types. It was further determined that the increased frequency of the predominating type corresponds to increased activity of geomagnetic storms, aurora, and ionospheric disturbances. The distribution of circulation types by days and months are given, and the anomalies in the monthly mean frequencies of the types are described. Among the conclusions are the following: Characteristic properties of the circulation types can be observed for each phase in the 11-year cycle. The predominant type in a phase tends to appear in definite months. The frequency characteristics of the types can be used in forecasting the frequency of the types throughout the year. The similarity of the sequence of predominant types to the stages of the secular and 11-year cycles allows the predominant type to be predicted. N.E.N.

N68-33588*# Volt Technical Corp., Washington, D. C.
APPLICATION OF OPTICAL PUMPING TECHNIQUES TO STUDIES OF GEOMAGNETIC GRADIENTS: THE PARTICULAR CASE OF "SEASIDE" EFFECT
Jean Mosnier Greenbelt, Md. NASA. Goddard Space Flight Center 7 Aug. 1968 24 p refs Transl. into ENGLISH from a FRENCH thesis
(Contract NAS5-12487)
(NASA-CR-96275; ST-GM-EXP-10738) CFSTI: HC $3.00/MF $0.65 CSCL 08N

The various improvements and advancements in magnetometers for studying the variation in time of the earth's magnetic field are summarized. Attention is focused on the geophysical applications of a magnetometer with optical pumping in the potassium vapor for studying a phenomenon called the seaside effect. The seaside effect is delineated as the telluric current distribution under the action of an electric conduction discontinuity of the ground. The geophysical applications of the optical pumping magnetometer is discussed in relation to a study of magnetic correlations in the Massif Central, and the magnetomarine effects. Results showed that by utilizing the magnetic resonance of potassium atoms oriented by optical pumping, a magnetometer capable of measuring the terrestrial field with great precision is possible. Results are also given on a study in which a magnetometer with an operating magnet capable of studying variation of declination was tested. B.S.D.

14 INSTRUMENTATION AND PHOTOGRAPHY

Includes design, installation, and testing of instrumentation systems; gyroscopes; measuring instruments and gages; recorders; transducers; aerial photography; and telescopes and cameras.

N68-32299# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
THEORY OF AMPLITUDE NUCLEAR MAGNETIC RESONANCE CONVERTER [TEORIYA AMPLITUDNOGO YAMR PREOBRAZOVA TELYA]
A. L. Skripko Nov. 1967 19 p refs Transl. into ENGLISH from Fiz. Metody Avtmat. Avtomat. Kontrolya Frunze (USSR), 1964 p 24–38
(FTD-MT-24-313-67; AD-671874)

The theory of an NMR-converter, the basic element of which is an induction coil with the investigated substance placed inside it, is considered. A vector diagram is presented, allowing the interrelationship between the different coil parameters to be traced graphically. It follows from the diagram, in particular, that the effect of the emf developed at resonance is equivalent to the corresponding change in resistance. The method for constructing the circular diagram is used to investigate the dependence of the complex voltage drop at the coupled impedance on detuning from the resonance condition. Analysis of the procedural errors is carried out, and recommendations for increasing the accuracy of measurements are given. The requirements imposed on the measuring circuit are analyzed. The theory of an NMR-converter as applied to NMR-hygrometers is considered. Author (TAB

N68-32320 Texas Univ., Austin.
A STUDY OF THE EFFECT OF BAFFLE WIDTH ON THE BEAM PATTERNS OF PLANAR ARRAYS OF SONAR TRANSDUCERS
Richard Edwin Douglass (Ph.D. Thesis) 1967 140 p
Available from Univ. Microfilms: HC $6.60/MF $3.00 Order No. 67-14820

This study is concerned with the effect of baffle width on the beam patterns of planar arrays of sound projectors. The study is based on an analytical model in which an array of rectangular sound projectors is mounted in a ribbon or strip-like baffle. The main conclusions derived from the study of the beam patterns are: (1) The difference between the beam pattern of an array in a finite baffle and that of the same array in an infinite baffle increases as the steering of the array varies from broadside to endfire. (2) Increasing the size of the array or the width of the baffle causes the finite-baffle beam pattern to approach the infinite-baffle beam pattern in a peculiar manner. (3) For a given array steered to endfire, the baffle dimension which influences most the beam pattern is the width of the baffle extending past the edge of the array toward which the beam is steered. Dissert. Abstr.

N68-32373# Naval Ordnance Lab., White Oak, Md. Explosion Dynamics Div.

SINGLE PULSE ENERGY MEASUREMENTS

Louis A. Rosenthal 27 May 1968 33 p refs

(NOLTR-68-67; AD-671808)

A technique for measuring the energy in a single electrical pulse or burst is developed. The preferred method employs an electrothermal converter as a detector, the output of which is amplified and integrated in a ballistic manner. Calibration is based on a generated single pulse whose action is obtained from dc measurements. A complete instrument is described and some observed measurements are given. Author (TAB)

N68-32384# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

SCANNING DEVICE UTILIZING A FIBER-OPTICAL CONVERTER

O. I. Karyagin 27 Nov. 1967 12 p refs Transl. into ENGLISH from Tekhnicheskaya Kibernetika. (Moscow), 1965 p 326-330

(FTD-MT-24-314-67; AD-671954)

The Institute of Automation and Telemechanics reports the development of a fiber-optical scanning device. The device is intended for optical scanning of a signal in the form of a moving dot. The time necessary to scan an n x n element surface is reduced by a factor of n by virtue of a scanning concept which consists of sequential scanning of two mutually perpendicular strips 1 element wide and n elements long. The time necessary to scan one element and one element zone is assumed equal because of the form of the input signal. The image transformer consists of glass fibers which are packed into bunches and arranged into a matrix. The control circuit generates a staircase signal which is allowed to momentarily pass through a gate where a coincidence between the clock pulse and the signal from the pm tube occurs. Author (TAB)

N68-32391# Applied Physics Lab., Johns Hopkins Univ., Silver Spring, Md.

A SPHERICAL FOCUSED BLAST DEVICE

Russell L. Mc Cally May 1968 55 p refs

(Contract NOw-62-0604-c)

(TG-1001; AD-671802)

A spherical explosive device that, by selective multipoint initiation, concentrates its energy in a beam along any of several aiming axes is described. Aiming is accomplished by electronically selecting the proper group of detonators, thereby eliminating the necessity of physically aiming the charge as is required in all other focused blast devices. Once fired, these initiators cause a nearly cylindrical detonation wave, collapsing on the focusing axis, which forces the explosive products out along this axis. Three small 1/4 lb. C-4 spherical focused blast devices have been built and fired. The explosion products velocity, shock wave velocity and peak pressure along the focusing axis were measured. These blast parameters were compared with similar ones measured for centrally initiated spheres; the purpose being to achieve a quantitative measure of the degree of focusing. The comparisons revealed that considerable gains over isotropic blast result from this focusing method. Furthermore the focusing appears to be a far field effect in that the values of peak pressure and the shock velocity are nearly equal to those of the centrally initiated sphere in close but tend to fall off much less rapidly with distance. Another result of interest is that the data obtained from the small, 1/4 lb., 2 inch diameter, centrally initiated spheres are in very good agreement with similar data scaled from much larger spheres. Author (TAB)

N68-32430 National Lending Library for Science and Technology, Boston Spa (England).

ON THE SUBJECT OF THE DESIGN OF AUTOMATIC SYSTEMS OF VOLTAGE REGULATION IN HORIZONTAL MERCURY ELECTROLYSERS [K VOPROSU O POSTROENII SAR NAPRYAZHENIYA NA GORIZONTAL'NYIH RTUTNYIH ELEKTROLIZERAKH]

A. V. Ogorodnik Nov. 1967 8 p refs Transl. into ENGLISH from Khim. Tekhnol. (Moscow), v. 3, 1965 p 95-99

(RTS-4193) Available from Natl. Lending Library, Boston Spa, Engl.: 17s 6d

A study of an electrolytic bath with a mercury cathode as a regulator has shown that the most important parameter which determines the cost of manufacture of the production article is the voltage. Voltage losses of 0.2-0.3v in each bath in the case of a large number of them in series, and loads of the order of 100,000a, lead to considerable losses of D.C. electric energy and to the lowering of current output at the cost of increased working temperature in the electrolyser. The problem of creating a system of voltage regulation with electrolysers with a mercury cathode is a very actual one. Its basic problem is the choice of the most effective method for regulating voltage and its evaluation from the point of view of the standard of regulation and possibility of its application in automation. Author

N68-32493# Institut fur Plasmaphysik G.m.b.H., Garching (West Germany).

A METHOD TO INCREASE THE TRANSMITTED LIGHT OF THE FABRY-PEROT INTERFEROMETER [UBER EINE METHODE DIE TRANSMISSION EINES FABRY-PEROT-INTERFEROMETERS ZU ERHOEHEN]

K. Buechl Mar. 1968 24 p refs In GERMAN; ENGLISH Summary

(IPP-3/71) CFSTI: HC $3.00/MF $0.65

In a Fabry-Perot interferometer the intensity of the transmitted light is small relative to that of the incident light. A method is described which produces an increase by a factor to two in the transmitted light. To a close approximation the image of the light source is not affected. To employ this method the light must be polarized and the plasma gradients small. Author

N68-32527# Texas Instruments, Inc., Dallas.

HIGH-SPEED, LONG-WAVELENGTH COHERENT RADIATION DETECTORS Final Technical Report, 15 May 1967-14 May 1968

Robert L. Williams Jun. 1968 63 p refs

(Contract N00014-67-C-0497; ARPA Order 269)

(TI-08-68-38; AD-671853)

The first section deals with the appearance of dielectric relaxation time constant components. These arise when the drift length of holes becomes comparable to the electrode separation, so that a significant fraction of the photogenerated holes is swept from the crystal. Under these conditions, which correspond to having the photoconductive gain of the order of or greater than unity, there is a maximum D^* bandwidth product. The second section is concerned with the D^* bandwidth calculation and also

points up the superiority of p-i-n diode performance over that of photoconductors if speed in excess of 10 to the minus 9th power second is required at 10.6 microns. In the third section gettering and contact effects are reported. It is shown that a gallium diffused layer getters copper from Ge:Hg. Using radioactive copper, we have demonstrated a very irregular distribution of copper in the vicinity of the diffusion profile. Some general considerations on heterodyne detection form the fourth section of the report. Serious inefficiencies arise with misalignment of the local oscillator beam on an intrinsic photoconductor. A collinear mode of operation is shown to eliminate this effect, and studies of transparent contacts are reported. Finally, the loss of signal for misalignment of local oscillator and signal beams was calculated for a variety of detector sizes and 10.6 micron radiation. Author (TAB)

N68-32828 Michigan State Univ., East Lansing.
THE MICHIGAN STATE UNIVERSITY SIX GAP β-RAY SPECTROMETER AND ITS APPLICATION TO THE β AND γ-RAY SPECTROSCOPIC STUDIES OF Sr^{83} AND Te^{131M}
Louis Martin Beyer (Ph.D. Thesis) 1967 161 p
Available from Univ. Microfilms: HC $7.60/MF $3.00 Order No. 67-14474

A six gap, iron core β-ray spectrometer has been constructed. The instrument, often called the orange spectrometer because of its geometric similarity to an orange, is similar to the one described by Bisgard. The spectrometer and its associated components are discussed in detail. A semi-quantitative theory of the focusing properties of a 1/5 field is included and the defocusing components of the field that are characteristic of this type of instrument are discussed. The orange spectrometer and the MSU iron free $\pi\sqrt{2}$ spectrometer have been used to investigate the internal conversion electron and positron spectra emitted in the decay of ^{83}Sr. Information on the multipolarities of the strongest transitions has been obtained. The M2 multipolarity assignment of the 42.3 keV transition, in conjunction with existing coincidence and lifetime measurements, show that the low energy features ($\leq$804.6 keV) of the decay scheme are uniquely determined. Dissert. Abstr.

N68-32596# Boeing Co., Wichita, Kans.
BRIGHTNESS BALANCE CRITERIA FOR ILLUMINATED DISPLAYS
H. W. Horn 22 May 1968 84 p refs
(D3-7647; AD-671353)

Investigation of potentially effective measures to achieve balanced illumination of aircraft displays was conducted. The theory was advanced that the apparent brightness (apparent luminance) sensation is identical with the sensation of glare. Four classical approaches to glare were examined; Transformed for apparent luminance applications; and equivalence criteria evaluated in the laboratroy. Results indicate that the fry revision of the scattering theory of glare provided a feasible solution which, with the use of the Pritchard photometer equipped with integrating glare lens, can be adapted for display evaluation. It was recommended that further experimental study be implemented to establish firm corroboration and refine measurement techniques. Author (TAB)

N68-32704*# California Univ., Berkeley. Sea Water Conversion Lab.
STUDY OF PERMEABILITY CHARACTERISTICS OF MEMBRANES Quarterly Reports, 9 Nov. 1967-9 Apr. 1968
K. S. Spiegler, J. C. Th. Kwak, A. D. Zelman, and J. Leibovitz 9 Apr. 1968 17 p refs Prepared for JPL
(Contracts NAS7-100; JPL-952109)
(NASA-CR-96282; QR-1; QR-2) CFSTI: HC $3.00/MF $0.65 CSCL 14B

Design of a novel apparatus for the measurement of all membrane transport parameters under the influence of electrical, osmotic, and pressure forces is reported. This apparatus was planned with a view to measure all transport properties under the same conditions of concentration and solution flow, and incorporate suitable feedback mechanisms so as to keep the solution concentrations throughout the measurement constant in spite of the mass transfer which takes place. Because the membrane is thus held in a constant environment, it is hoped that valid correlations of the different transport processes can be achieved. A plan of experiments is outlined. Author

N68-32722# Long Island Univ., Greenvale, N. Y. Science Engineering Research Group.
ENVIRONMENTAL MEASUREMENTS AND INSTRUMENTATION DATA IN SUPPORT OF NAVOCEANO AERIAL COLOR PHOTOGRAPHY TESTS Final Technical Report
Edward Yost, Sondra Wenderoth, and Robert Anderson Apr. 1968 90 p
(Contract N00014-67-C-0281)
(SERG-TR-02; AD-671847)

Measurements of incident and reflected solar radiation of the surface and underwater environment were made at the Atlantic Undersea Test and Evaluation Center at Andros Island in the Bahama Islands during the period 10 February to 25 February 1968. These data include: the intensity and spectral distribution of solar radiation incident upon the surface; the relative spectral reflectance of surface targets; and beach areas; the spectral intensity and distribution of solar radiation at various depths beneath the water and reflected by the bottom as well as the backscatter spectrum of the water. Calibration data on the spectroradiometric equipment and the four lens multispectral camera are provided. Spectral photographic results indicative of that which can be expected from the test have been included. Author (TAB)

N68-32758# Harvard Univ., Cambridge, Mass. Div. of Engineering and Applied Physics.
THE CONSTRUCTION AND ANALYSIS OF A RATIO REFLECTOMETER
Paul T. McElroy May 1968 281 p refs
(Contract N00014-67-A-0298; ARPA Order 33)
(HP-20; AD-671824)

An optical-electronic system was designed and built for reflectivity studies which has the following characteristics. Amplitude changes as small as .05% can be detected, permitting the experimenter to measure fine structure and the effects of perturbations. The readout of reflectivity data is direct and rapid, and the sample volume is very large, enabling one to modify the sample crystal environment with a variety of stimuli. The discussion of the ratio reflectometer contains a full description of the design problems and the final form of the optical, mechanical, and electronic components. We deal with the various sources of noise and their reduction, the factors affecting linearity and its optimization, and scattered light and electronic drift as sources of false reflectivity structure. Normal operating conditions are described and a guide for locating system malfunctions is included. False reflectivity structure of small magnitude, arising from the polarizing characteristics of our monochromator grating, was exactly correlated with peaks in the I0 curve occurring under the same polarization conditions. The analysis shows the effect is not unique to our system; it may account for fine structure occasionally noted in the work of other investigators. Author (TAB)

N68-33022*# National Research Corp., Cambridge, Mass. Norton Exploratory Research Div.
STUDY OF NEW METHODS TO MEASURE LOW PRESSURE
Richard Hecht Washington NASA Aug. 1968 79 p refs
(Contract NAS1-5347)
(NASA-CR-1120) CFSTI: HC $3.00/MF $0.65 CSCL 14B

A theoretical and experimental evaluation of the concept of electrostatic control of capacitance-manometer sensitivity has been carried out. The results have been encouraging, although problems have been created by high-voltage breakdown at the electrode and diaphragm surfaces of the gauge. This breakdown can undoubtedly be eliminated by choosing more appropriate surface materials. It is hoped that absolute pressures well below 10^{-6} Torr can ultimately be measured with this gauge if uncertainties in work-function can be avoided; a voltage-modulation technique is suggested which should accomplish this. It is suggested that the use of superconducting-bolometers to detect the kinetic energy of incident gas molecules will permit absolute measurements of pressures as low as 5×10^{-9} Torr, and also measurements of molecular beam densities as low as 10^{6} molecules/cc. It is suggested that the juxtaposition of a low-frequency heater and a sensitive microphone will permit absolute pressure measurements as low as 10^{-6} Torr. Author

N68-33147# Los Alamos Scientific Lab., N. Mex.
DYNAMIC GAS FLOWMETER FOR ULTRA-HIGH VACUUM
N. G. Wilson 1968 15 p refs Presented at the 4th Gen. Meeting on Intern. Organ. for Vacuum Sci. and Technol., Manchester, England
(Contract W-7405-ENG-36)
(LA-DC-9000; Conf-680401-3) CFSTI: HC$3.00/MF$0.65

For studying low flow problems such as gas diffusion in metals, a dynamic flowmeter capable of measurements at less than 10^{-5} torr-liter/sec is needed. A flowmeter system based upon known transmission characteristics of diffuser screens and associated pressure drops is being studied. An assembly of four axially mounted nude Bayard–Alpert ionization gauges and calibrated diffuser screens has been constructed. Initial tests of the device indicate that flows ranging from 3×10^{-4} to 3×10^{-10} torr-liter/sec can be measured. The assembly is constructed of electropolished stainless steel components, high temperature feedthroughs, and nickel diffuser screens, and it is fully bakeable at temperatures up to 400°C. Characteristics of the flowmeter can be determined without absolute gauge calibration, since all pressure measurements are taken in terms of pressure ratios. Measurements of gas flows require calibration of at least one gauge in the flowmeter. By proper design and an initial known gas flow, calibration of all gauges in situ can be accomplished. Author (NSA)

N68-33177*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
ADVANCED INSTRUMENTATION AND DATA SYSTEMS
George H. Ludwig *In its* Aerospace Electron. Systems Technol. 1967 p 125–137 (See N68-33169 20-30)

The active evolutionary processes occurring in all portions of information systems are discussed in relation to the NASA-managed and operated space sciences satellites. The daily data volume from the Goddard Space Flight Center satellites is summarized in terms of both tapes produced by data acquisition stations and the number of measurements telemetered. An increase in data volume to over 500 million data points per day by 1973 is predicted. A general space information system is diagrammed, and it is pointed out that the demands for better integration of the entire information system are increasing because of the increasing interrelationships between the subsystems necessary to provide greater system performance. Developments in onboard processing, data acquisition, ground central data processing, and data reduction and display are described. Trends are identified as more onboard processing, data acquisition station automation, real-time or near-real-time data relay to the operating and data processing centers with the attendant fading of the distinction between real-time and final data processing, and new data processing programming and display techniques. M.G.J.

N68-33184*# National Aeronautics and Space Administration. Electronics Research Center, Cambridge, Mass.
ADVANCED INSTRUMENTATION AND DATA SYSTEMS
Gene G. Mannella *In its* Aerospace Electron. Systems Technol. 1967 p 221–232 (See N68-33169 20-30)

Required instrumentation and data system advances are discussed in the context of four types of future missions: the flyby probe, followed by the orbiting and then the landed experiment packages, and ultimately surface exploration by manned or unmanned instrumented laboratories. The problems posed by Martian and Venusian atmospheres are discussed to illustrate the instrumentation technology needed to develop versatile sensors and measurement techniques for successfully probing such different regimes. In order to cope with the volume and complexity of future measurements, improved capabilities must be achieved in data handling systems. These are envisioned as better off-line storage to handle functions such as systems monitoring, diagnostic test routines, and task scheduling, and an onboard computer to handle functions relating to guidance, display, telemetry, and scientific experimentation. Alternate approaches suggested include the use of a centralized system consisting of a large special purpose computer serving all the flight tasks in a time-shared manner, or a multiprocessing system involving a pool of identical memory and processing elements switched into appropriate combinations as one or more tasks demand service. M.G.J.

N68-33199*# Research Triangle Inst., Durham, N. C. Engineering and Environmental Sciences Div.
MATHEMATICAL MODEL PREDICTIONS AND OPTIMIZATION STUDY OF THE GAMMA RAY ATMOSPHERIC DENSITY SENSOR
D. R. Whitaker and R. P. Gardner Aug. 1968 80 p refs
(Contract NAS1-7046)
(NASA-CR-66676) CFSTI: HC$3.00/MF$0.65 CSCL 04B

Mathematical models were previously derived to study the response of a gamma-ray backscatter sensor for atmospheric density measurements. These models, developed for a cylindrically symmetrical geometry have been adapted to three-dimensional models having more general application. The models were then integrated with a multivariable search routine to optimize a sensor design for specific missions. Optimum design parameters for a Mars atmosphere density measurement were calculated. Author

N68-33259# Aerospace Research Labs., Wright-Patterson AFB, Ohio.
BASIC PARAMETERS FOR FILMS AND IMAGE INTENSIFIER-FILM COMBINATIONS AND PERFORMANCE COMPARISON Final Report
Radames K. H. Gebel, Gary L. Duke, and Hermann R. Mestwerdt Apr. 1968 32 p refs
(ARL-68-0073; AD-671504)

Some photographic emulsion densities (D) for Kodak Tri-X Pan and Kodak Royal-X Pan for Kodak developers D-19, DK-50 and HC-110, developing times 5, 8, 12 and 20 minutes and color temperatures 6100K, 2850K and 2040K were determined. From this the photographic conversion yield nF (average number of grains per total number of quanta incident to the emulsion) as a function of D was calculated. Pertinent equations for determining the most optimistic conditions for recording with film directly or with an image intensifier ahead of the film are derived. The intensifier is superior for equal signal-to-noise ratios. Author (TAB)

N68-33277*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
INVESTIGATION OF ELECTRON-RADIATION-INDUCED DIELECTRIC BREAKDOWNS IN A TYPICAL CAPACITOR METEOROID DETECTOR SYSTEM

George M. Storti, George E. Rambo, Herbert D. Hendricks, and Thomas B. Ballard Washington Sep. 1968 29 p refs
(NASA-TN-D-4738) CFSTI: HC $3.00/MF $0.65 CSCL 14B

The effects of electron radiation on capacitor-type detector systems similar to those used on the Pegasus satellite were investigated. Each system that was tested consisted of a polyurethane foam panel containing two capacitor-type-meteoroid detectors, several meters of polyethylene terephthalate insulated electrical leads, and other items such as rubber shock mounts and polyethylene terephthalate adhesive tape. Three different target thicknesses for the meteoroid detectors were tested, these thicknesses being 40, 200, and 400 microns (1.5, 8, and 16 mils). The incident kinetic energy of electrons used in the tests ranged from 30 keV to 1000 keV, and the temperature of the detector systems was maintained at either 197° K or 297° K. It was found that radiation-induced dielectric breakdowns were produced in the systems and that some of these signals were indicated as meteoroid penetrations. It was determined that the primary source of the breakdowns and, hence, the penetration indications was the polyethylene terephthalate insulated wire. The number of breakdowns and penetration indications obtained for a fluence of 5×10^{13} e/cm^2 was found to be dependent on the incident kinetic energy of the electrons and the system temperature; that is, more breakdowns and penetration indications occurred at the lower temperature (197° K) and the lower energies (30 keV to 100 keV). Tests were performed with different modifications made to the signal processing circuits. Several of these modifications resulted in a significant reduction or the total elimination of the radiation-induced penetration indications. Finally, it was found that those systems containing 200 and 400 micron detectors with 200- and 400-micron-thick targets suffered severe decreases in resistance in the capacitor-type detectors. Author

N68-33283 British Hydromechanics Research Association, Cranfield (England).
THE DEVELOPMENT OF A DECADE COUNTER
K. Foster (Birmingham Univ.) and D. A. Retallick (Birmingham Univ.) Oct. 1967 13 p refs
(RR-926)

Feasibility studies have now been completed and a prototype version of a ring counter has been developed. The counter design and preliminary test results are given. Examinations are made of the applications of counters in fluidic systems and the properties required in them. It is proposed that the twisted ring counter is suitable and this report includes design data and performance figures of a first prototype. Author

N68-33290*# Polish Academy of Sciences, Warsaw.
SPECTROMETER FOR INELASTIC SCATTERING OF THERMAL NEUTRONS STUDIES AT THE PULSED IBR REACTOR [SPEKTROMETR DO BADANIA NIESPREZYSTEGO ROZPRASZANIA NEUTRONOW TERMICZNYCH PRZY REAKTORZE IMPULSOWYM IBR]
Jerzy Sosnowski (Inst. of Nucl. Res., Swierk), I. Sosnowska (Warsaw Univ.), and E. Maliszewski (Joint Inst. of Nucl. Res.) 1968 18 p refs Presented at the IAEA Symp. on Inelastic Scattering of Neutrons in Solids and Liquids, Copenhagen, 20-24 May 1968 Submitted for publication
(Repr.-898/II/PS) CFSTI: $3.00

The design of the spectrometer for studies of inelastic coherent scattering of thermal neutrons by single crystals is described. A polichromatic pulse neutron beam is scattered by a single crystal sample and the energy of scattered neutrons is analysed by three analizing single crystals (for three different beams of scattered neutrons). The time of flight technique is used to measure the incident neutron energy. The spectrometer is adapted for simultaneous structure and lattice dynamics studies of solids. Special features of this spectrometer and its applications are discussed. Author

N68-33292*# Illinois Univ., Urbana.
THEORETICAL AND EXPERIMENTAL STUDIES OF THE UNDERLYING PROCESSES AND TECHNIQUES OF LOW PRESSURE MEASUREMENT Letter Report, 1 Jul. 1967–31 May 1968
R. N. Peacock, F. M. Propst, J. W. Culton, D. E. Coad, and G. G. Tibbetts 31 May 1968 9 p ref
(Grant NsG-376; Contract DAAB07-67-C-0199)
(NASA-CR-96465) CFSTI: HC $3.00/MF $0.65 CSCL 14B

An overview is presented on tests conducted to assess gauge errors caused by the different atmospheric compositions encountered in flight and the effect of the compositions on gauge surfaces. A low pressure vacuum system capable of accommodating the flight gauges, commercial B–A gauges, and Scheumann-type gauges was constructed to examine (1) gauge pressure indication in gas mixtures, (2) surface ionization effects in the flight modulated B–A gauges, and (3) relative sensitivities of gauges in different gases. Data are depicted to show the effect upon omegatron behavior of secondary electron emission from the electron collector, argon ions per ionizing electron (normalized) versus ionizing electron energy, helium ions per ionizing electron (normalized) versus ionizing electron energy, and B–A gauge ion current versus omegatron–Klopfer gauge ion current in argon and in helium using constant emission currents. M.G.J.

N68-33368*# Los Alamos Scientific Lab., N. Mex.
MASS SPECTROMETER FOR HIGH-TEMPERATURE INERT GAS ANALYSIS
N. G. Wilson and C. R. Winkelman 1968 17 p refs Presented at the 4th Gen. Meeting on Intern. Organ. for Vacuum Sci. and Technol., Manchester, England
(Contract W-7405-ENG-36)
(LA-DC-8999; CONF-680401-2) CFSTI: HC $3.00/MF $0.65

A mass spectrometer designed for analysis of inert gases at temperatures up to 300°C was developed for on-line analysis of cover gases in liquid-metal-cooled nuclear reactors. Use of a 100-liter/sec sputter-ion pump in series with a thermoelectrically cooled baffle and a 280-liter/sec oil diffusion pump is a new approach to ultra-clean vacuum system construction. No cryogenic fluids or absorbents are required to minimize background buildup from the sampled gases or from the oil diffusion pump. A differentially pumped gas inlet system allows sample rates varying from less than 1×10^{-5} torr-liter/sec to greater than 1 rott-liter/sec. The differentially pumped flow splitting chamber is isolated from back diffusion of mechanical pump oil vapor by an ionization baffle. Operation of the system for approximately six months in tests showed negligible buildup of hydrocarbon backgrounds. The quadrupole mass filter used provides integral mass resolution for mass numbers from 1 to 500. Scan rates of 10 sec to 400 μsec per mass number allow conventional strip chart or digital recording techniques, or direct view on an oscilloscope. Author

N68-33380 Florida Univ., Gainesville.
RADIO FREQUENCY GAS CHROMATOGRAPHIC DETECTORS
Howard Person Williams (Ph.D. Thesis) 1966 86 p
Available from Univ. Microfilms: HC $4.60/MF $3.00 Order No. 67-13172

A practical and theoretical treatment of two radio frequency gas chromatographic detectors is given. One detector is comprised of two matched Clapp oscillators, operating at 70 mcs., a mixer, and a frequency meter. The sensing element is a capacitor in which a steady state r.f. glow discharge is sustained using helium as a carrier gas. Any gas injected into the carrier gas gives a frequency change in the sample oscillator and consequently a difference frequency between the two oscillators. The other detector is composed of a Clapp oscillator with a r.f. glow discharge occurring in the series tank circuit as above. The sensing element is a gold-plated probe placed in the glow discharge plasma. A potential

difference between the probe and the ground electrode is read by a vacuum tube boltmeter. Any change in gas composition is noted by a change in potential difference. Both detectors are highly sensitive and have large ranges of linear response, i.e., 10^2 to 10^3.
Dissert. Abstr.

N68-33392# Advisory Group for Aerospace Research and Development, Paris (France).
ADVANCED TECHNIQUES FOR AEROSPACE SURVEILLANCE
W. T. Blackband, ed. 1968 425 p refs Presented at the 13th Sym. of the Avionics Panel of AGARD, Milan, 4–7 Sep. 1967 (AGARD-CP-29) CFSTI: HC $3.00/MF $0.65

During this symposium various techniques for surveillance by aircraft and satellites are reviewed. Discussed are photography or television, millimeter wave side-looking radar or optical radar, and infrared and millimeter radiometry. For individual titles see N68-33392—N68-33415

N68-33393# Laboratoire de Recherches Balistiques et Aerodynamiques, Vernon (France).
MEASUREMENT OF VISIBLE LUMINANCE ON RUSTIC TERRAIN [MEASURE DES LUMINANCES APPARENTES DE PAYSAGE TERRESTRES]
J. P. Loisel *In* Agard Advanced Tech. for Aerospace Surveillance 1968 p 1–12 refs In FRENCH (See N68-33392 20-14)

To assess the physical factors affecting surveillance, airborne photographic and phtotmetric measurements were made of atmospheric transmission and luminous interference. Vertical observations of both level and natural terrain were made at altitudes of 15,000 meters and 30,000 meters. Transl. by M.G.J.

N68-33395# AQMEL Electronique et Mecanique d' Aquitaine, Billere (France).
CONTROL OF LENSES BY THE MEASURE OF THEIR MODULATION FACTOR AND COMPARISON WITH A THEORETICAL STUDY [CONTROLE DES OBJECTIFS PAR LA MESURE DE LEUR FACTEUR DE MODULATION ET COMPARAISON AVEC L'ETUDE THEORIQUE]
Jacques Pouleau *In* AGARD Advanced Tech. for Aerospace Surveillance 1968 p 27–44 In FRENCH (See N68-33392 20-14)

A method of determining the modulation transfer function is described for use in the quality control of photographic lenses to prevent image degradation. It can also be applied for calculating numerically the quality of the optical system. In the technique, the photographic lens is considered as a spatial filter by which to measure the passbands and then to optimize the grouping of the different elements. Transl. by M.G.J.

N68-33396# Air Force Systems Command, Wright-Patterson AFB, Ohio.
PASSIVE MICROWAVE SENSING OF THE ATMOSPHERE AND EARTH SURFACE ENVIRONMENTS
C. V. Falco (Aerojet-General Corp.) and W. J. Johnson *In* AGARD Advanced Tech. for Aerospace Surveillance 1968 p 45–64 refs (See N68-33392 20-14)

The recent advances in microwave radiometry as applied to radio astronomy can be applied to earth surveillance. Used in this way these techniques can reveal cloud structure and atmospheric water content, sea state and ground temperature. They also can be applied to hydrological research. In this paper an account is given of the basic physical principles of microwave radiometry. The discussion covers the differences in information content of radiometry with horizontal and vertical polarisation and factors affecting the choice of angle of elevation for viewing and the working frequency. It is shown that for the most comprehensive information, radiometry of horizontally and vertically polarised signals taken separately combined with simultaneous use of both high and low working frequencies is needed.

N68-33397# Air Force Systems Command, Wright-Patterson AFB, Ohio. AF Avionics Lab.
SPECTRAL CHARACTERISTICS OF GROUND OBJECTS AND BACKGROUNDS WITH REFERENCE TO GROUND SURVEILLANCE
B. K. Wernicke *In* AGARD Advanced Tech. for Aerospace Surveillance 1968 p 65–84 refs (See N68-33392 20-14)

This paper deals with some of the characteristics of ground objects and their possible backgrounds which can be measured from airborne platforms. For simplicity, the discussion is limited to the so-called "optical zone" of the electromagnetic spectrum, although it should be evident that this represents only a sample of the possible characteristics which could be measured. The applications of the measured data are manifold, from peacetime uses concerned with aerial surveys to a variety of military situations.
Author

N68-33402# Deutsche Versuchsanstalt fur Luft- und Raumfahrt, Oberpfaffenhofen (West Germany).
A CONTINUOUSLY CALIBRATED MICROWAVE RADIOMETER
J. P. Hach *In* AGARD Advanced Tech. for Aerospace Surveillance 1968 p 167–186 refs (See N68-33392 20-14)

In contrast to the well known Dicke technique, the radiometer described in this paper uses a second reference, T_f, thus not only eliminating the influence of receiver noise temperature fluctuations on the reading but also the influence of receiver gain fluctuations. This reference is a series connection of a gas discharge noise tube and a resistive attenuator. The receiver input is periodically switched between T_a, T_u, and T_g, T_f. Two synchronous detectors process the modulated input signal so that the output is proportional to $(T_f+T_o-2T_a)/(T_f-T_o)$. Since the constant of proportionality is inherent in the post-detection and integration components, by proper design, it can be made independent of time and environment conditions. In most practical cases the minimum detectable signal is approximately the same as that of a Dicke radiometer with corresponding integration time constant.
Author

N68-33403# Westinghouse Electric Corp., Baltimore, Md. Defense and Space Center.
RECEIVING AND RECORDING THE WIDE DYNAMIC RANGE OF SIGNALS OF A SIDE-LOOKING RADAR SYSTEM
E. M. Arnold *In* AGARD Advanced Tech. for Aerospace Surveillance 1968 p 187–196 (See N68-33392 20-14)

This paper describes a mechanization technique for recording the wide dynamic range of received signals of a side-looking radar (SLR) system on photographic film consistent with the limited dynamic range of the human eye. In addition, this technique provides flexibility for the receiver transfer function so that many variations can be attained without significant redesign of the receiver.
Author

N68-33404# Westinghouse Electric Corp., Baltimore, Md. Defense and Space Center.
A TRADEOFF BETWEEN RANGE AND AZIMUTH PERFORMANCE IN SIDE-LOOK RADAR
Myron S. Wheeler *In* AGARD Advanced Tech. for Aerospace Surveillance 1968 p 197–214 refs (See N68-33392 20-14)

When used with very short transmitter pulses, the long end-fed antennas typical of side-look radar result in a transient problem which degrades the pattern as compared with the normal steady-state far-field pattern. The extent of the effect depends upon the receiver bandwidth and the transmitter pulse shape as well

as the antenna design. A spectral solution to this problem is used, permitting an evaluation of receiver bandwidth effects. This is compared with a more limited time domain solution and the two are in agreement. It is found that the less the receiver bandwidth the less the transient losses; but, with usual bandwidths, the antenna length should be no more than half the pulselength as it travels on the transmission line filling the aperture. Author

N68-33405# Compagnie Generale de Telegraphie Sans Fil, Paris (France).
SIDE-LOOKING RADAR USING A SYNTHETIC ANTENNA [RADAR A FAISCEAU LATERAL UTILISANT UNE ANTENNE SYNTHETIQUE]
G. Revillon *In* AGARD Advanced Tech. for Aerospace Surveillance 1968 p 215–240 refs In FRENCH (See N68-33392 20-14)

Techniques using side-looking radar with synthetic antennas are discussed. Different methods used to obtain higher resolution are described, and the technical problems involved in each are assessed. Transl. by M.G.J.

N68-33406# Marconi Instrument, Ltd., St. Albans (England).
LOW LIGHT LEVEL AERIAL RECONNAISSANCE USING TELEVISION TECHNIQUES
P. R. Groves and J. E. Rowntree *In* AGARD Advanced Tech. for Aerospace Surveillance 1968 p 241–258 (See N68-33392 20-14)

The aim of this work was to investigate the feasibility of extending the range of aerial reconnaissance photography to full night conditions, using available light only. The principle of operation of the Image Isocon is outlined and its advantages and disadvantages indicated. For the reconnaissance requirement, an electronic method to counteract image movement due to the forward motion of the aircraft is described. At low light levels lag in the picture is troublesome and a system for eliminating this effect is indicated. Techniques for recording the reconnaissance information on both film and tape are given and results presented demonstrate the performance of the system down to starlight conditions. Author

N68-33407# Rome Air Development Center, Griffiss AFB N. Y.
ADVANCED WIDEBAND RECORDING AND READOUT
A. A. Jamberdino *In* AGARD Advanced Tech. for Aerospace Surveillance 1968 p 259–280 (See N68-33392 20-14)

In recent years, the various users of data derived or collected by electronic means have demanded higher and higher storage densities and wider bandwidths, with a minimum loss of information. The magnetic recording industry has tried to keep up with the increased requirements and has been successful in satisfying many requirements. For a large percentage of applications, however, it appears that magnetic storage techniques will never be able to cope with the increased requirements. In order to meet the increasing demands placed on the storage industry by various using organizations, more advanced methods had to be investigated. The most promising methods include electron beam and laser beam techniques. Recording media for these methods include thermoplastics, silver halides, and photoplastics. Experimental models using these techniques have been fabricated and demonstrate packing densities of an order of magnitude greater than those of the magnetic techniques with bandwidth capabilities of 10 and 50 MHz, and predictions to 100 and even 200 MHz. Author

N68-33408# M-O Valve Co., Ltd., Wembley (England).
ELECTRONOGRAPHY
L. S. Allard and C. J. Emberson *In* AGARD Advanced Tech. for Aerospace Surveillance 1968 p 281–292 refs (See N68-33392 20-14)

Electronography is the recording of information by the direct impingement of an electron beam on a recording medium such as an electron sensitive emulsion (G5) or direct print-out paper, e.g. Linagraph. The method of allowing the beam to pass through a thin window of mica in the tube face to bombard the recording emulsion in air has been investigated. Mica windows, about 3 μm thick, have been sealed successfully and have withstood normal tube processing schedules. Electron beam currents of about 2 nA at 25 keV energy have given recordable traces of width about 10 μm when the film has been stationary and in contact with the mica window. The experiments undertaken so far have indicated that control of the spacing between film and window at 15 μm is possible. The recordings obtained have indicated the complete elimination of phosphor noise from the trace, this being one of the problems associated with conventional tube recording techniques. Author

N68-33409# Royal Radar Establishment, Malvern (England).
RECENT DEVELOPMENTS IN CATHODE RAY TUBE RECORDERS AND DISPLAYS
W. A. Woodley *In* AGARD Advanced Tech. for Aerospace Surveillance 1968 p 293–302 (See N68-33392 20-14)

Developments are reviewed in both CRT film recording and direct view display fields. Modern high resolution fibre optic CRT's make use of black clad low numerical aperture fibre optic faceplates to solve film transport problems. CRT's complete with coils and mumetal screen provide a packaged component giving an easy "plug in" replacement facility. Narrow angle black clad fibre optics are used to give a high contrast screen for direct view display CRT's operating in high ambient light conditions. A method of measuring the spatial frequency response of CRT's and fibre optic plates is described. Author

N68-33410# AFG-Kernenergieanlagen, Frankfurt Am Main (West Germany).
ELECTROLUMINESCENCE DISPLAY DEVICES
W. Berthold *In* AGARD Advanced Tech. for Aerospace Surveillance 1968 p 303–316 (See N68-33392 20-14)

A number of electroluminescent devices are described, which appear attractive for the display of digital data. Their application is particularly useful where small depth, low power consumption and high reliability under severe mechanical vibration is required. The examples illustrate typical cases for the display of symbols and one-or-two-dimensional arrangements for the display of different parameters of a system or for the indication of the position of several targets. Large screens can be composed of smaller units. Four colours are available, blue, green, orange and pink, which could be applied in multi-colour display screens to characterise different kinds of targets. Author

N68-33412# Centre National d'Etudes Des Telecommunications, Issy-Les-Moulineaux (France).
STATISTICAL ANALYSIS OF PHOTOGRAPHIC IMAGES [ANALYSE STATISTIQUE D'IMAGE PHOTOGRAPHIQUES]
Daniel Estournet and Pierre-Yves Schwartz *In* AGARD Advanced Tech. for Aerospace Surveillance 1968 p 329–352 In FRENCH (See N68-33392 20-14)

Statistical data are presented on various methods for assessing photographic analyses. Preliminary results are given on aerial photography and on other photographic techniques. Further refinements are seen as image transmission with compressed data, forms of signal analysis, and analysis of fine quasi-periodic signals. Transl. by M.G.J.

N68-33413# International Institute for Aerial Survey and Earth Sciences, Delft (Netherlands).
INTERPRETATION EXPERIENCE WITH SATELLITE COLOUR PHOTOGRAPHS, SIDE-LOOKING RADAR PICTURES AND INFRARED SCANNING RECORDS

S. A. Hempenius, H. van der Meer Mohr and J. Vermeer *In* AGARD Advanced Tech. for Aerospace Surveillance 1968 p 353–368 refs (See N68-33392 20-14)

This paper deals with: (1) geometry (scale, verticality, angular field, flight and scan-direction, stereoscopy, distortion); (2) energy (colour and filters, wavebands and wavelengths, weather capabilities, timing and season); (3) image quality (magnification, smallest details visible and traceable, contrast in the terrain); (4) flight planning (coverage and navigation, type of terrain and area to be recorded, orientation on existing maps); (5) data handling (measurable quantities, display equipment, evaluation of interpretation results); and (6) professional training and terrain experience, adaptation to unconventional imagery, possibility of field-work. Some conclusions are that satellite colour photographs of arid regions are of practical use; large scale IR scans will find application in hydrology; side-looking radar may prove useful for small-scale regional studies and all-weather disaster survey. Author

N68-33414# Institute for Perception RVO-TNO, Soesterberg (Netherlands).
DISCRIMINATION AND IDENTIFICATION IN NOISY LINE-SCAN PICTURES
W. A. Wagenaar and A. van Meeteren *In* AGARD Advanced Tech. for Aerospace Surveillance 1968 p 369–386 refs (See N68-33392 20-14)

The interpretation of line-scan pictures was examined as a function of image degradation. Pictures were produced with a flying-spot-scanner system. Degradation was achieved by varying the line frequency and by adding noise. Eight subjects were instructed to indicate which object was imaged on the picture presented. Scores are plotted as a function of line frequency for three signal-to-noise ratios and three different groups of military vehicles. Maximum scores are reached for line frequencies between 3 and 5 lines per m in reality. Incorrect answers were analysed with respect to the structure of the confusions. The various kinds of confusions lead to a series of interpretation tasks with increasing complexity. Author

N68-33416# General Electric Co., Utica, N. Y.
SYNTHESIS OF COVERT-RADIATED HIGH-RESOLUTION TV SYSTEMS FOR NIGHTTIME RECONNAISSANCE AND SURVEILLANCE
T. B. Kent and P. F. Sargent *In* AGARD Advanced Tech. for Aerospace Surveillance 1968 p 387–404 refs (See N68-33392 20-14)

The discussion of covert-radiated TV systems for nighttime use is concentrated into three areas: (1) A description of recent equipment developments and an assessment of their performance; (2) the development of a technique and general equation to relate the radiant power requirements to all of the significant parameters of the system. These include the radiation of the source, the performance of the camera tube, the spectral requirements, the lens speed, and the atmospheric attenuation; and (3) the design of a high resolution system using the general equation which defines overall performance. Author

N68-33422 Michigan State Univ., East Lansing.
A RESONANT CAVITY HIGH FREQUENCY OSCILLOMETER
Dante Anthony Costanzo (Ph.D. Thesis) 1967 195 p
Available from Univ. Microfilms: HC $8.80/MF $3.00 Order No. 67-14490

A high frequency oscillometer operating at 100 megacycles per second was developed. A reentrant cavity was employed as the resonant circuit element. High frequency voltage was induced in the cavity by inductive coupling of the cavity to a constant voltage and constant frequency generator. The current flowing in the cavity was indicated by a tuned detector circuit which was capacitatively coupled to the cavity. The high frequency energy received by the detector probe is rectified and applied to the grid circuit of a d.c. amplifier tube which is part of a modified Wheatstone Bridge circuit. Bridge unbalance current is linearly related to signal intensity. One electrode of a precision variable condenser was directly connected to the inner cylinder and the other electrode was connected to the outer cylinder of the cavity. Connected in parallel with the electrodes of the precision variable condenser was a condenser-type cell. Dissert. Abstr.

N68-33432# Cambridge Electron Accelerator, Mass.
CALIBRATION AND PERFORMANCE OF CEA QUANTAMETERS
George F. Dell and Mircea Fotino 1 May 1968 28 p refs Presented at the Symp. on Beam Intensity Measurement, Daresbury, England, 22–26 Apr. 1968
(Contract AT(30-1)-2076)
(CEAL-1040; CONF-680430-1) CFSTI: HC $3.00/MF $0.65

Five gas-filled quantameters and two evacuated units for use as nonsaturable secondary emission quantameters were tested. Saturation curves, ion collection curves, stability, and dependence of monitor response on absorber in the beam are presented. NSA

N68-33495# Polish Academy of Sciences, Cracow.
SCINTILLATION DETECTOR FOR β+ RADIATION REGISTERING COINCIDENCES OF ANNIHILATION GAMMA QUANTA [SCYNTYLACYJNY DETEKTOR PROMIENIOWANIA β+ REJESTRUJACY KOINCYDENCJE ANIHILACYJNYCH KWANTOW GAMMA]
L. Pomorski and J. Wilczynski Apr. 1968 17 p refs In POLISH; ENGLISH summary
(INP-605/PL) CFSTI: $3.00

A coincidence detector for β+ radiation registering scintillations of annihilation gamma rays to be used in the activation analysis by ^{3}He ions of low energy was constructed. A brief technical description of this arrangement is given. The efficiency of β+ detection is 1.4%, and the background 0.7 counts per minute. Author

N68-33558 Rice Univ., Houston, Tex.
VISCOSITY OF HELIUM-NITROGEN MIXTURES AT LOW TEMPERATURES AND HIGH PRESSURES
James Tzu-Fen Kao (Ph.D. Thesis) 1967 208 p
Available from Univ. Microfilms: HC $9.45/MF $3.00 Order No. 67-13089

An absolute capillary tube viscometer which is capable of measuring viscosity of gas from above ambient to cryogenic temperature with pressure up to 500 atm has been designed and constructed. The viscometer is the first of its kind with regard to its application to low temperature and its unique feature of maintaining the whole flow system at the same temperature. The necessary viscometric equation for calculating viscosity from the viscometer has been derived. The proximity to and deviation from steady state operation for the viscometer in question has been clarified. The analysis also sheds some light on its low pressure application. Experimental viscosity data have been determined for helium-nitrogen system of 5 approximately equally spaced compositions at the temperature of 50°C over the pressure range from 10 to 500 atm, 9 compositions at 0°C from 10 to 500 atm, 7 compositions at −50°C from 10 to 400 atm and 5 compositions at −90°C from 10 to 200 atm. Dissert. Abstr.

15 MACHINE ELEMENTS AND PROCESSES

Includes bearings, seals, pumps, and other mechanical equipment; lubrication, friction, and wear; manufacturing processes and quality control, and reliability; drafting; and materials fabrication, handling, and inspection.

N68-32327 National Lending Library for Science and Technology, Boston Spa (England).
EXPERIMENTAL DEFINITION OF THE THICKNESS OF THE OIL FILM IN DYNAMICALLY LOADED SLIDING FRICTION BEARINGS [EKSPERIMENTAL'NOE OPREDELENIE TOLCHSHINY MASLYANOGO SLOYA V DINAMICHESKI NAGRUZHENNOM PODSHIPNIKE SKOL'ZHENIYA]
A. A. Pyatnitskii and S. M. Kureiko Nov. 1967 9 p ref Transl. into ENGLISH from Detali Mashin i Podemno-Transp. Mashiny Misioved Resp. Nauchno-Tekhn., no. 2, 1965 p 71–76
(RTS-4259) Available from Natl. Lending Library, Boston Spa, Engl.: 12s 6d

Apparatus and methods are described to measure the thickness of oil films in dynamically loaded sliding friction bearings working under conditions of fluid friction. Capacitive elements fitted into the shaft and bearing, and used in conjunction with a tensometer and oscillograph, enable measurement of the thickness of the oil film at any point and in accordance with any law of change of loading on the bearing. A calibrating procedure for the tensometer is detailed using a vertical optimeter. This technique was used to investigate dynamically loaded bearings of an automatic sheet metal press. D.H.B.

N68-32336 California Univ., Davis.
A KINETIC STUDY OF THE REMOVAL OF THIN FILMS FROM HARD SURFACES
Willard Charlson Hamilton (Ph.D. Thesis) 1967 111 p
Available from Univ. Microfilms: HC $5.60/MF $3.00 Order No. 67-14972

The kinetics of the removal of pure radioactive tristearin from a stainless steel surface has been followed by means of the decrease in radioactivity. A previously recognized interface-activated mechanism of soil removal is discussed and appears to be related to the long-known though much neglected Marangoni effect. This mechanism, which may be the most powerful cleaning mechanism in a system, is due to surface motion created by local variations in the surface tension. The effects of several variables on this mechanism of soil removal were investigated and are discussed. The reverse step, redeposition of soil onto the stainless steel, is shown to be negligible under the existing experimental conditions. The transport of the removed soil over the water/air interface is eliminated as a contributing factor to the observed kinetics. The soil removal mechanism is therefore found to be a one step process governed by the kinetic step of the dissolution of the soil at the soil/air/water boundary line. Dissert. Abstr.

N68-32352# Bureau of Mines, Pittsburgh, Pa.
PRINCIPLES FOR SAFE HANDLING OF LIQUID HYDROGEN
Joseph Grumer, Alexander Strasser, and Robin A. Van Meter Jun. 1967 33 p refs

Recommendations based on an extensive literature survey and on safety practices at various installations are presented. Consideration is given to fires and explosions which constitute the most serious hazard. Fire control and safe practice in hydrogen storage and transfer are discussed. Prompt and accurate detection of hydrogen leaks is stressed, together with the need for better detection devices. Adequate supervision and training of personnel is also discussed. Author

N68-32388# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
EDDY CURRENT DEFECTOSCOPES [TOKOVIKHREVYYE DEFEKTOSKOPY]
P. I. Beda and I. P. Parshin 13 Sep. 1967 7 p Transl. into ENGLISH from Byull. Tekh.-Ekon. Informatsii (Moscow), no. 4, 1966 p 30–31
(FTD-HT-23-252-67; AD-671587)

Several new eddy-current flaw detectors were developed recently at an unidentified plant. The VDZL-64 flaw detector is intended to trace surface defects, primarily fatigue cracks, in parts made of nonmagnetic heat-resistant materials, such as turbine blades. It reveals surface cracks as small as 0.6 X 0.15 X 0.005 mm in size. Two opposite slots of a blade are tested simultaneously. The VDZL-65 flaw detector is similar to the VDZL-64 and has the same sensitivity, but it tests simultaneously three upper slot pairs. The VDL-2M flaw detector traces cracks in heat-resistant nonmagnetic materials with 0.5--1 m/ohm (sq. mm) electric conductivity and in thin edges of enameled and bare turbine blades, nozzles, etc. It reveals cracks with a depth of 1 mm or more. The VDTs-1 flaw detector is a universal instrument which can be used for materials with an electric conductivity of 0.1--60 m/ohm (sq. mm), including ferromagnetic materials with a relatively uniform magnetic structure. It can be used for checking fins with a minimum thickness of 2 mm, fillets with a minimum radius of 2 mm, and areas around rivets, holes, bearings etc. It has a measuring mechanism and indicators similar to those of the VDL-2 detector. It can reveal cracks with a minimum length and depth of 1--3 mm and 0.2--0.3 mm, respectively, and can be used for checking coated parts without removing the protective coating. The flaw detectors reveal flaws which cannot be discovered by other means. These instruments, and especially the VDL-2M and VDTs-1 detectors, can also be successfully used to verify results obtained by other methods. Author (TAB)

N68-32408 National Lending Library for Science and Technology, Boston Spa (England).
CALCULATION OF THE AMOUNT OF REDUCTION OF FORGINGS PRODUCED BY FREE FORGING [RASCHET STEPENI UKOVA POKOVOK, POLUCHAEMYKH SVOBODNOI KOVKOI]
I. Elfmark and S. Turon Dec. 1967 18 p refs Transl. into ENGLISH from Kuznechno-Shtampovochnoe Proizvodstvo (Czechoslovakia), no. 12, 1965 p 11–17
(RTS-4075) Available from Natl. Lending Library, Boston Spa, Engl.: 17s 6d

A new procedure is described for determining amount of reduction during manufacture of forgings of various shapes from ingots. The calculation of amount of reduction follows from the assertion that elongation can be replaced partially by upsetting the ingot. It is assumed that the influence of upsetting is less than drawing, and that it is necessary to weld up the defects inside the ingot, which is reflected in equations for the amount of reduction as an equivalence factor A. The new method for calculating amount of reduction permits proper determination of the optimum reduction for elongated forgings, discs and rings produced by forging on an expanding bar with increase in width, and hollow forgings produced by drawing out on a mandrel between tools. Author

N68-32458 British Hydromechanics Research Association, Cranfield (England).
FLOW IN THE BARSKE-TYPE PUMP
P. Grocock (Loughborough Univ.) and R. K. Turton (Loughborough Univ.) 1967 9 p refs Presented at the 9th Members Conf., Cranfield, Sep. 1967
(SP-912)

The basic principles of the Barske-type pump are discussed, and preliminary results obtained from a 9.5 inch diameter impeller

rig are given, compared with the suggestions made by Barske, and alternative proposals advanced. Modifications to the rig are described and a full test program outlined which it is hoped will support the tentative conclusions as to the fluid behaviour in the impeller, vaneless space and diffuser. Author

N68-32480 British Hydromechanics Research Association, Cranfield (England).
EXPERIMENTAL EVIDENCE ON THE NEL METHOD OF MIXED-FLOW PUMP AND FAN DESIGN
D. J. Myles (Natl. Eng. Lab.) 1967 14 p refs Presented at the 9th Members Conf., Cranfield, Sep. 1967
(SP-928)

A method for the design of mixed flow pumps and fans in the specific speed range 4700 to 7000 (gal/min ft rev/min units) was proposed in 1965. Although minor modifications have been made in detail design and the computer is now used to scan a wider range and combination of variables, some nine pumps and fans have been designed and tested using the same basic technique. The paper attempts to correlate the findings obtained by experiment with the method adopted. From overall characteristic tests on models ranging from 16 inches to 30 inches inlet flange size, head and flow at the best efficiency point are compared with design values. As one of the aims was to investigate the stability of the head flow characteristic shape, the instability coefficient, defined as the dip in head from peak to trough as a fraction of peak head in the region of blade stall, is compared with blade loading coefficients derived from the various machines. Pressure and velocity measurements determined at intermediate stations throughout a fan and pump are also presented. The paper concludes with research currently being carried out on this type of machine which will lead to improvement in stator vane design and a better prediction of annulus loss. Author

N68-32477 British Hydromechanics Research Association, Cranfield (England).
PHYSICAL CHARACTERISTICS OF SELF-PRIMING PHENOMENA IN CENTRIFUGAL PUMPS
D. Rachman (Strathclyde Univ.) 1967 16 p refs Presented at the 9th Members Conf., Cranfield, Sep. 1967
(SP-911)

A brief resume of priming methods for centrifugal pumps by internal recirculation is followed by the description of two research pumps used to investigate the priming process phenomena. The findings are then discussed in a general manner showing some common features. It is found that the maximum obtainable priming lift for a centrifugal pump is a function of the impeller tip speed and not pump configuration. This is followed by a further analysis of the effects of speed and outlet angle on the air pumping characteristics, which show certain basic differences between the parallel flow layout and the contra-flow and shroud-reflux method. An explanation is offered for some instability tendencies and this is supported by pressure and velocity distribution measurements obtained in the pump casings. The quantity of fluid retained in the pump casing and the separator design are closely related to the temperature rise and air bubble separation. The turbulence losses in the pump during priming are suprisingly heavy and produce a rapid rise in temperature which causes the evacuation performance to drop rapidly. The bubble separation problem is not clearly understood but calls for an adequate free surface area and low recirculation velocities to prevent re-entrainment. Tests conducted on the pump, used as a gas compressor, show that the suction pressure affects the head generated to an increasing degree as the lift increases beyond 15 ft. In conclusion, it is stated that the degree of turbulence of the process of air-water mixture generation makes it impossible to devise a rational design procedure. Nevertheless, some understanding of the flow pattern and pressure distribution can considerably aid development work and should be closely studied. Author

N68-32524# Polytechnic Inst. of Brooklyn, N. Y. Electrical Engineering Dept.
MODELS, ANALYSIS, AND APPROXIMATIONS FOR SYSTEM RELIABILITY AND AVAILABILITY
Martin Messinger Jun. 1967 312 p refs
(Contract AF 49(638)-1402)
(PIBMRI-1365-67; AFOSR-67-1438; AD-671474)

Probabilistic models are formulated for the computation of the system reliability in terms of the component reliabilities. Emphasis is placed on obtaining bounds and approximations that can be used to simplify the necessary computation. In evaluating the usefulness of these results the concept of goodness is introduced. The system structure is modeled in terms of a reliability graph. From the minimal cut sets of the reliability graph, good bounds are obtained for the high reliability region, and from the minimal tie sets, good bounds are obtained for the low reliability region. For the special case of the k out of n structure, useful approximations are developed for the system reliability based on the normal and Poisson approximations, and for the special case of chain type structures, the Weibull reliability function is shown to provide a good approximation to the system reliability. Two models are considered for the analysis of non-repaired systems with component dependence. The first is the state dependent hazard model where the component hazards are assumed to be conditional only on the set of failed components and not on the times at which these failures occur. The second case treated is where the component hazards are functions of the present time and times of all previous failures. Mathematically, the first case is treated as a Markov process and the second case is treated by means of multiple integrals. Finally, analog and Monte Carlo simulation are considered. Author (TAB)

N68-32540 National Lending Library for Science and Technology, Boston Spa (England).
HEATING OF TUBES DURING DRAWING IN AN ULTRASONIC FIELD [NAGREV TRUB PRI VOLOCHENII V UL'TRAZVUKVOM POLE]
V. P. Severdenko and Yu. N. Reznikov Jan. 1968 10 p refs Transl. into ENGLISH from Dokl. Akad. Nauk Belorussk. SSR (Minsk), v. 10, no. 6, 1966 p 388–390
(RTS-4302) Available from Natl. Lending Library, Boston Spa, Engl.: 7s/8d

Copper tube heating during drawing under ordinary conditions and in the presence of ultrasonic oscillations was investigated. Tube temperature reached 350 to 370° K during nonmandrel drawing in an ultrasonic field at low drawing speeds of 100 to 150 mm/min². Two series of experiments were conducted on copper tubes of 1.5mm in die that had been annealed and pickled in sulfuric acid. In one series the effect of ultrasonic sound exposure for different periods of time was considered; in the other the nature of the change in tube temperature during the drawing process was studied. Ultimate tensile stress of the metal was reduced about 2% during heating. M.W.R.

N68-32641 National Lending Library for Science and Technology, Boston Spa (England).
MANUFACTURE OF METALLURGICAL SEMI-FINISHED PRODUCTS FROM CARBONYL NICKEL POWDER. PART 1
B. A. Borok, R. P. Shchegoleva, and L. S. Golubeva 8 Jun. 1968 9 p refs Transl. into ENGLISH from Poroshkovaya Met. (Ukraine), v. 8, no. 4, Apr. 1968 p 29–36 /ts Transl. No. 68/153
Available from Natl. Lending Library, Boston Spa, Engl.

Processing of carbonyl nickel powder into rods and strips by the plastic working of sintered billets is described. The powder is pressed isostatically under 9 kg/mm² pressure into cylindrical billets that are sintered in hydrogen with a dew point between −20 and −30° C at 1380° C for 5 hr. Metal yield of 85% is reported when the billets are forged into bars at temperatures between 900 and 1200° C; the billets are first surface milled to

planed and then hot or cold rolled into sheets or strips. Hydrogen annealing results in higher mechanical properties than does air annealing. Two different processing techniques are noted; one of which reduces costs and losses because it eliminates forging and machining of the bar surface. M.W.R.

N68-32547 National Lending Library for Science and Technology, Boston Spa (England).
SURFACE HEAT TREATMENTS: CARBURIZING AND CARBONITRIDING [I TRATTAMENTI TERMICI SUPERFICIALI DI CARBURAZIONE E CARBONITRURAZIONE]
P. Verdicchio and A. Rosatelli 29 Jul. 1968 8 p Transl. into ENGLISH from Met. Ital. (Milan), v. 60, Feb. 1968 p 77–80 In ITALIAN and ENGLISH *Its* Transl. 68/182
Available from Natl. Lending Library, Boston Spa, Engl.

Properties of a carburized layer and a carbonitrided layer were compared for use on 20NiCrMo2 (SAE8620) steel. It was found that although carbonitriding is useful for improving wear and dimensional stability, it is not advisable for general use and is more expensive than carburizing. Under some conditions the hardenability of the carbonitrided layer was better than for the carburized layer. This means that hardening can be accomplished in a less harsh medium and that deformations will, thereby, be reduced. The nature of the layer has no significant effect on fatigue strength and impact strength. M.W.R.

N68-32548 National Lending Library for Science and Technology, Boston Spa (England).
RELIEVING OF HIGH SPEED STEEL [HINTERDREHBARKEIT VON SCHNELLARBEITSSTRAEHLEN]
Otto Muelders and Rolf Meyer-Rhotert 6 Jun. 1968 20 p Transl. into ENGLISH from Deut. Edelstahlwerke Tech. Ber. (Krefeld), v. 4, no. 2, 1964 p 84–92 In ENGLISH and GERMAN
(EE-Trans-1764) Available from Natl. Lending Library, Boston Spa, Engl.

Test methods were investigated for the metal cutting or relieving of high speed steels. Influence of cutting conditions, tensile strength, increased sulfur content in steel, coolants, and lubricants on the relieving properties was studied. Tests on two steels indicated that high surface qualities required suitable metal cutting conditions and the addition of sulfur and/or intermediate hardening and tempering to a tensile strength of 100 to 130 kg/mm^2. Use of coolants and lubricants, found to be of lesser importance, was unable to take the place of the sulfur addition or the hardening and tempering. M.W.R.

N68-32551 National Lending Library for Science and Technology, Boston Spa (England).
WEAR STUDIES ON METALS AND NON-METALLIC ABRASIVE PARTICLES EXPOSED TO GRANULAR MATERIALS [GLEITVERSCHLEISS-UNTERSUCHUNGEN AN METALLEN UND NICHTMETALLISCHEN HARTSTOFFEN UNTER WIRKUNG KOERNIGER STOFFE]
K. Wellinger, H. Uetz, and M. Guerleyik 29 Jul. 1968 41 p refs Transl. into ENGLISH from Wear (Amsterdam), v. 11, 1968 p 173–199 In ENGLISH and GERMAN *Its* Transl. 68/139
Available from Natl. Lending Library, Boston Spa, Engl.

Investigations on sliding wear of different metallic and hard nonmetallic materials by the abrasive paper and the wear-pot method have been carried out. The abrasive particles glass, flint, corundum and silicon carbide had a hardness between VHN = 500 and 2700 kg/mm^2. For the wear of pure metals and carbon steels low/high-level characteristics were found. For the nonmetallic materials somewhat different results were obtained. Besides the influence of material hardness and modulus of elasticity, the effect of cold working and that of age hardening were tested in the case of copper beryllium alloy. In addition there were some researches on the action of a higher content of residual austenite for steels. Surface films formed in normal atmosphere cause partially dissimilar amounts of wear in respect to the behavior in a vacuum of about 10^{-4} torr. The film formation is dependent on the cold working of the material. Author

N68-32556 National Lending Library for Science and Technology, Boston Spa (England).
INFLUENCE OF OXIDE FILMS ON FRICTION AND WEAR DURING SLIDING
A. W. J. de Gee 28 May 1968 7 p refs Transl. into ENGLISH from Materialpruefung (Duesseldorf), v. 9, May 1967 p 167–169 (CE-TRANS-4743) Available from Natl. Lending Library, Boston Spa, Engl.

Comparatively thick oxide films generally inhibit the formation of adhesive bonds between the sliding surfaces and thus reduce friction and wear. However, in some cases introduction of oxygen may well increase the adhesion between sliding surfaces, due to the formation of monomolecular oxide films, which locally bond the surface together. This is illustrated on the basis of results obtained with the silver/iron friction-pair. Author

N68-32559 National Lending Library for Science and Technology, Boston Spa (England).
COMPARATIVE TESTS ON FRICTION COEFFICIENT AND WEAR WITH AQUEOUS LUBRICANTS AND MINERAL OIL
K. Ehrlenspeil [1968] 15 p refs Transl. into ENGLISH from Vdi (Ver. Deut. Ing.) Z. (Duesseldorf), v. 108, no. 17, Jun. 1966 p 737–741 *Its* Transl. 1139
Available from Natl. Lending Library, Boston Spa, Engl.

Aqueous lubricants—particularly polyethylene oxide dissolved in water, and also a solution of dextrin in water—were compared on a sliding-friction test rig and on a gear-wheel-loading test rig as to their frictional behaviour with mineral oil of the same viscosity. A considerably lower friction in the mixed-friction region, but a higher wear, resulted for these substances in a comparison with mineral oil. Plastic gear wheels achieve longer life periods in aqueous lubricant than they do in mineral oil. The corrosion-resistance of the aqueous lubricant with respect to steel is not entirely satisfactory. Author

N68-32565 National Lending Library for Science and Technology, Boston Spa (England).
AN X-RAY DIFFRACTION STUDY OF CONSOLIDATION PROCESSES IN THE ROLLING OF NICKEL POWDERS
G. I. Aksenov, O. K. Kolerov, and V. P. Revyakin 29 Jul. 1968 18 p refs Transl. into ENGLISH from Poroshkovaya Met., Akad. Nauk Ukr. SSR (Kiev), v. 8, no. 5, May 1968 p 59–67 In ENGLISH and RUSSIAN *Its* Transl. 68/200
Available from Natl. Lending Library, Boston Spa, Engl.

As a result of an investigation of the compressibility of nickel powders during strip rolling, it was established that the best compressibility over the $P_{sp.\ max}$ range 12.5-67 kN/cm^2 (1.25-6.7 tons/cm^2) is exhibited by atomised powder and the poorest compressibility by carbonyl-nickel powder. Using the techniques of X-ray diffraction analysis, it was determined that the broadening of the interference lines of carbonyl-nickel specimens is linked with the size of the coherent-scattering regions, the magnitude of microdistortions and the presence of stacking faults. The presence of stacking faults in the starting carbonyl nickel and strips rolled from it confirms that the crystal-growth and plastic deformation processes are governed by a dislocation mechanism. The relationship $M\Delta a/a \simeq 0.4d$, obtained for cold-deformed bulk nickel, has been found to apply also to the rolling of carbonyl-nickel powder over the range $P_{sp.\ max}$ = 46-67 kN/cm^2 (4.6-6.7 tons/cm^2). Author

N68-32589 National Lending Library for Science and Technology, Boston Spa (England).
THE HARDNESS OF ELECTROSPARK-DEPOSITED PRECIOUS-METAL LAYERS [DIE HAERTE FUNKENELEKTRISCH AUFGETRAGENER EDELMETALLSCHICHTEN]
Herbart Hoeft, Dietmar Boettcher, and Rainer Steinelt 29 Jul. 1968 10 p refs Transl. into ENGLISH from ZIS (Zentralinst. Schweisstech.)-Mitt. (Halle), v. 10, 1968 p 146–152 In ENGLISH and GERMAN *Its* Transl. 68/140
Available from Natl. Lending Library, Boston Spa, Engl.

Microhardness of electrospark-deposited precious metal layers on brass and nickel was studied. Maximum and minimum hardness data of contact materials as found in the literature was summarized and the maximum increase in hardness was derived. Both the increase in hardness and fluctuations in hardness were found to decrease with increasing hardness of the starting materials. Hardness increase was, on the average, by a factor of 1.6 to 4.0; and this increase was explained by an enhanced lattice vacancy concentration. Data are included for Ag, AgPd, Pd, and Au. M.W.R.

N68-32637# Grumman Aircraft Engineering Corp., Bethpage, N. Y.
ELECTROCHEMICAL MACHINING—PROCESS AND TOOLING DEVELOPMENT (PHASE 1) FOR FERROUS ALLOYS
H. Schillo Aug. 1968 39 p
(FSR-AD8-08-68.1)

Design criteria governing tool construction, workpiece geometry, repeatability, and tolerance limits were established. Process parameters were defined for the type and concentration of electrolytes needed for machining a large number of steel alloys. Dimensions of rectangular cuts can be controlled to within ± 0.005 inch with a high degree of repeatability. Low alloys and stainless steels in the annealed and normalized conditions were qualified for electrochemical machining. Notched tensile and fatigue tests were made to qualify heat treated D6AC steel and the 17-4 PH and 410 stainless steels for electrochemical machining. Preliminary results of sustained load tests with notched tensile specimens indicate that hydrogen embrittlement has not occurred. K.W.

N68-32655 National Lending Library for Science and Technology, Boston Spa (England).
ELECTRON BEAM WELDING [ELEKTRONNO-LUCHEVAYA SVARKA]
G. A. Nikolaev and N. A. Ol'shanskii Dec. 1967 45 p Transl. into ENGLISH from the book "Novye Metody Svar. Met. Plast." 1966 p 53–90
(RTS-4279) Available from Natl. Lending Library, Boston Spa, Engl.: 40s

Principles, applications, and technical and operational advantages of vacuum electron beam welding are discussed. S.C.W.

N68-32663*# Motorola, Inc., Phoenix, Ariz. Semiconductor Products Div.
BONDING LARGE AREA SILICON WAFERS
Jul. 1968 31 p Prepared for JPL
(Contracts NAS7-100; JPL-952022)
(NASA-CR-96283; QR-4) CFSTI: HC $3.00/MF $0.65 CSCL 13H

Progress in both solid–liquid and solid–solid interdiffusion bonding of large area wafers to substrates is described. The liquid bonds are primarily fabricated of Au with In and/or Sn as the wet layer. The solid state bonds have been made chiefly with the Au-Ag system. The problem of voiding which dominates both the SLID and SSID bonding projects is discussed as to causes and possible solutions. Bonds of 2-inch multidevice wafers to molybdenum substrates using both methods have been made and the devices tested. Initial data on the thermophysical properties phase of the program are presented. These include the thermoconductivity of several eutectic alloys and alloys of the Ag-In system. Also the thermal expansion of the Ag-In solid solution is presented. Modifications in the mechanical properties measurements along with progress in this phase are also described. The first data from the stress analysis computer program yields some insight into the stress patterns of a trilayer bond system using gold solder. These results indicate a certain transparency to stress in the solder layers used to make bonds. Author

N68-32676 National Lending Library for Science and Technology, Boston Spa (England).
PRACTICAL EXPERIENCE ON HEAT-TREATMENT OF DROP FORGINGS UTILISING THE HEAT FROM PRIOR DEFORMATION [PRAKTISCHE ERFAHRUNGEN BEIM WAERMEBEHANDELN VON GESENKSCHMIEDESTUECKEN AUS DER VERFORMUNGSWAERME]
Richard Werner and Hans Zeilinger 29 Jul. 1968 19 p refs Transl. into ENGLISH from Haerterei-Tech. Mitt. (Freiburg), v. 23, 1968 p 27–34 In ENGLISH and GERMAN *Its* Transl. 68/145
Available from Natl. Lending Library, Boston Spa, Engl.

Theoretical principles of heat treatment which are based on the possibility of using the inherent heat of deformation for subsequent heat treating processes are discussed; design details of a suitable heat treatment facility are described; and experiences gained from hot work heat treatments using the proposed drop forgings technique are reviewed. S.C.W.

N68-32689 National Lending Library for Science and Technology, Boston Spa (England).
ON AN IMPORTANT DIRECTION OF HEAT REMOVAL IN A CUTTING TOOL [OB ODNOM VAZHNOM NAPRAVLENII TEPLOOTRODA V TOKARNOM REZTSE]
G. I. Yakunin and F. Ya. Yakubov Dec. 1967 5 p ref Transl. into ENGLISH from Izv. Akad. Nauk Uz. SSR, Ser. Tekhn. Nauk (Tashkent), no. 6, 1965 p 53–54
(RTS-4388) Available from Natl. Lending Library, Boston Spa, Engl.: 5s

As the direction of heat removal is an important factor in cutting tool design, consideration is given to the case where the maximum amount of heat is removed along the leading surface, parallel to the main cutting edge, to the side directed away from the top of the tool. It is hypothesized that in the plane perpendicular to the main cutting edge, two heat currents meet: one is directed perpendicular to the leading surface; the other perpendicular to the main rake surface. The total heat flow from the leading and main rake surfaces is directed parallel to the main cutting edge. Therefore, the quantity of heat removed in a given direction, and consequently the durability of the cutting tool, depends on the position of the top of the tool relative to its longitudinal axis. Experimental verification of this hypothesis showed that the heat flow parallel to the main cutting edge exerts a considerable effect on durability. M.G.J.

N68-32718# Nuklearni Institut Jozef Stefan, Ljubljana (Yugoslavia).
RELATIONSHIP OF THICKNESS IN COMPRESSION ACTION PARAMETERS [ABHAENGIGKEIT DER DICHTE VON PARAMETERN DES VERDICHTUNGSVORGANGES]
J. Vdovic Feb. 1968 62 p refs In GERMAN
(NIJS-R-528) CFSTI: HC $3.00/MF $0.65

Studied is the dependence of press- or sintering density on pressure, temperature, and time parameters. Developed are qualitative functions with free constants that are then fitted to experimental results. Emphasis is placed on the press density at repeated pressures as well as at load removal. Results show good agreement with experimental data and it is concluded that test results can be projected by various functions of similar geometries. Transl. by G.S.

N68-32735*# Harvey Engineering Labs. for Research and Development, Torrance, Calif.
RESEARCH PROGRAM TO DEVELOP A TECHNOLOGY IMPROVEMENT PROGRAM FOR CLOSED DIE FORGING Final Report
J. R. Long, L. W. Davis, and P. E. Anderson Nov. 1966 100 p for Appendices 1 and 2, See N68-15676
(Contract NAS8-20093)
(NASA-CR-96323; HA-2288) CFSTI: HC $3.00/MF $0.65 CSCL 13H

To demonstrate the improvement possible through the use of high temperature dies, a series of upset forging tests were run on 7075 aluminum alloy, 811 titanium alloy, and 250 maraging steel. The dies were designed for quick mounting in the hydraulic press so that they could be heated in a furnace and rapidly transferred to the press and locked in place. A method of heating by oxy-acetylene torches was also used, particularly for the higher temperatures. For the 7075 alumimum, the material was heated to 800°F and the dies heated to 400° to 800°F. Increasing die temperatures produced thinner discs with greatly reduced unit forging force. The 811 titanium and 250 maraging steel material was heated to 1950°F, and the dies were heated to 400° to 1400°F in 200° increments. The titanium data show significant and consistent lowering of the unit forging force and production of thinner discs through 1200°F die temperature. Although the maraging steel data are incomplete, they indicate a consistent trend of lower unit forging force and thinner discs with increasing die temperatures.
M.G.J.

N68-32760*# Research Triangle Inst., Durham, N. C.
PRACTICAL RELIABILITY. VOLUME 2: COMPUTATION
Washington NASA Aug. 1968 138 p refs
(Contract NASw-1448)
(NASA-CR-1127) CFSTI: HC $3.00/MF $0.65 CSCL 14D

This report places in perspective the role of automatic digital computations in design for reliability. It is intended for the design engineer, the systems engineer, and the test engineer as well as the reliability specialist. The degree of detail with which the various topics are treated is sufficient to enable the engineer not previously familiar with the subject to properly select and use the methods presented. The report first briefly describes the computer, how it is used, and some of the mathematical problem types that are amenable to computer solution. The orientation to reliability is then provided in a brief perspective of reliability tasks and the relation of the computer to them. Later sections treat specific reliability tasks and explore the mathematical methods related to them and how the computer is used to implement them. Some specific computer programs are identified and their uses illustrated by examples. Parameter variation analysis and reliability prediction are treated. The last section treats some recent developments in communicating with the computer which make it more suitable to engineering and reliability applications.
Author

N68-32779*# Research Triangle Inst., Durham, N. C.
PRACTICAL RELIABILITY. VOLUME 3: TESTING
Washington NASA Aug. 1968 298 p refs
(Contract NASw-1448)
(NASA-CR-1128) CFSTI: HC $3.00/MF $0.65 CSCL 14D

Testing is discussed from an engineering viewpoint. The subject is structured in terms of basic test types, basic problem types amenable to treatment by the basic test types, and applications of testing in hardware programs. The emphasis is on basic principles and practical problems in implementing them. Generally, the discussion emphasizes testing for reliability rather than reliability testing in the formal sense. Part I is devoted to concepts, definitions and general procedures. In particular, a section on test classifications considers the many ways of viewing tests and some of the prevalent confusion in terminology is resolved. Parts II and III collectively treat the basic test and problem types. The manner of separating these discussions into the two parts serves to highlight an important consideration in testing which is often overlooked, viz., whether or not aging is important. Part IV contains discussions on several subjects including nondestructive testing, environmental testing, and accelerated testing which are common to several or all of the basic test types. Part V surveys the major applications of testing in hardware programs and draws special attention to applications associated with reliability. An Appendix contains discussions of the mathematical topics pertinent to testing.
Author

N68-32934*# National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.
LUBRICATION AND WEAR OF BALL BEARINGS IN CRYOGENIC HYDROGEN
H. W. Scibbe, D. E. Brewe, and H. H. Coe Washington 1968 34 p Presented at Bearing Conf., Hanover, N. H., 4–6 Sep. 1968
(NASA-TM-X-52476) CFSTI: HC $3.00/MF $0.65 CSCL 13I

Rolling element bearings used in liquid hydrogen turbopumps have lubrication, material, and design requirements somewhat different from those used in high-speed oil lubricated applications. The bearing load-carrying surfaces are lubricated by transfer films provided from a self-lubricating cage material. The bearings are designed for minimum heat generation at high speed by using open race curvatures and small diameter balls. In addition to the self-lubricating feature, the cage must have adequate strength and be designed with proper clearances to prevent seizure or excessive wear in the cold environment that can result in premature bearing failure. With proper materials and design 40 mm bore ball bearings have operated successfully in −400°F hydrogen gas at 20,000 rpm. Cage wear with four Teflon-compound materials was less than 0.25 percent of the original cage weight for running times up to 10 hours.
Author

N68-32955# Oak Ridge National Lab., Tenn.
EVALUATION OF SLIDING SEALS FOR OPERATION IN DRY HELIUM
A. A. Abbatiello and F. H. Neill Jun. 1968 24 p
(Contract W-7405-ENG-26)
(ORNL-TM-1661) CFSTI: HC $3.00/MF $0.65

An evaluation was made of elastomer O ring seals and chevron seals for piston ring and shaft seal service in a dry helium atmosphere with operating temperatures up to 350°F. Preceding tests had demonstrated that the combination of elastomer seals supported by polymer rider rings and lubricated with a dry film lubricant could best meet the required service conditions. The present limited investigation was undertaken to define seal life, to determine the upper temperature limit on satisfactory seal performance for O ring seals, and to determine the leakage from metallic and nonmetallic chevron seals. Conditions simulated were piston load, rubbing velocity, operating temperature, temperature cycles, and cylinder dwell periods expected during a full year of operation. The criterion of successful operation was that the total leakage past the piston and shaft seals during a test be no greater than the total volume displaced by the piston during the test period. At 350°F the O ring seal combination performed adequately for its anticipated life. Limited tests on polymeric and metallic composition chevron seals indicated that they were not satisfactory for the present application without added development.
Author (NSA)

N68-32977*# National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.
EXTRUSION OF 1/2 AND 3/8-INCH-DIAMETER THIN-WALL TUNGSTEN TUBING IN LENGTHS NEAR 10 FEET
Charles Blankenship and Charles A. Gyorgak Washington Aug. 1968 15 p refs
(NASA-TM-X-1638) CFSTI: HC $3.00/MF $0.65 CSCL 13H

Thin-wall tungsten tubing was extruded in lengths of 7.5 to 10.6 feet (2.3 to 3.2 m) using the floating mandrel technique. Tubing diameters were either 1/2 or 3/8 inch (1.27 or 0.95 cm), and nominal wall thicknesses were 0.020 inch (0.05 cm). In most of the tubes, variations in diameter and wall thickness over a length of 8 to 10 feet (2.5 to 3 m) were less than 0.020 and 0.008 inch (0.05 and 0.02 cm), respectively. Feasibility of warm drawing (1300° F or 700° C) the extruded tubing was demonstrated. Drawing greatly improved tubing surface finish and dimensional tolerances. Author

N68-33027*# SKF Industries, Inc., King of Prussia, Pa. Research Lab

SUPERSONIC TRANSPORT LUBRICATION SYSTEM INVESTIGATION, PHASE 2, FIRST PERIODICAL REPORT

W. L. Rhoads 22 May 1968 65 p refs

(Contract NAS3-6267)

(NASA-CR-72424; AL68T046) CFSTI: $3.00 CSCL 13I

Ball bearings and bellows face seals for use on Mach 3 aircraft turbine engine mainshafts have been tested in screening tests using jet lubrication and inert gas blanketing. Bearing operating temperatures up to 700°F have been explored under typical engine load and speed conditions with the seals exposed to 1200°F air and to a pressure differential of 100 psi. Of the three lubricants evaluated, Mobil Jet II ester (MIL-L-23699 specification) permitted thermal system instabilities resulting in bearing failures at temperatures in excess of 550°F. Mobil XRM 154D silicone oil was found to have adequate lubricating properties but exhibited the tendency to form thermal decomposition products even in an inert atmosphere which appears to render it unsuitable for long-term operation. Mobil XRM-109F synthetic hydrocarbon with Kendex high molecular weight mineral-oil base resin additive was found suitable for operation to 700°F and will be run in longer-term tests. No bearing-originated difficulties of operation were observed with either XRM-109F or XRM 154D lubricants. Author

N68-33038# Stanford Univ., Calif. Dept. of Statistics.

QUALITY CONTROL UNDER MARKOVIAN DETERIORATION

Sheldon M. Ross 14 Jun. 1968 23 p refs

(Contract Nonr-225(53))

(TR-110; AD-671825)

The report considers the situation in which a production process may be in any one of a countable number of states and that the quality of the item produced is a function of this underlying state. It is also supposed that the state of the process at time t is not known and only becomes known when an item is sampled. There are inspection, production, and revision costs. The report provides a framework for handling problems of this nature. It also treats in detail a 2-state version of this problem. Author (TAB)

N68-33065*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

LUBRICATION AND WEAR OF BALL BEARINGS IN CRYOGENIC HYDROGEN

H. W. Scibbe, D. E. Brewe, and H. H. Coe [1968] 31 p refs Presented at the Dartmouth Coll. Bearing Conf., Hanover, N. H., 4-6 Sep. 1968

(NASA-TM-X-61165) CFSTI: HC$3.00/MF$0.65 CSCL 13I

Several basic design and material requirements of ball bearings used in liquid hydrogen turbopumps are presented. Among these are the selection of (1) an internal design with geometric factors that minimize heat generation within the bearing due to ball spin, (2) a ball-race material with good dimensional stability and adequate low-temperature ductility, (3) a self-lubricating cage material that provides lubricant on the bearing load carrying surfaces and has a long wear-life, and (4) a cage design with adequate strength and sufficient clearances at the operating cryogenic temperatures. Most of the information was obtained from experimental bearing programs conducted in cryogenic hydrogen (both liquid and cold gas). Author

N68-33068# General Dynamics/Astronautics, San Diego, Calif.

THE DEVELOPMENT OF A LOW COST COMPLEX WAVE MACHINE FOR QUALITY CONTROL VIBRATION TESTS

J. D. Peterson 31 Dec. 1958 10 p

(AD-671450)

Quality control vibration tests of missileborne electrical and electronic equipment are an additional quality control tool for the purpose of exposing assembly defects or sub-standard components which may not be detected by normal inspection means. The first phase of testing used the existing sine wave vibration equipment. The tested items of equipment were, in most cases, powered and operating, but were not specially instrumented to detect malfunctioning during the vibration tests. The second phase of testing incorporated operation and instrumentation of each component during vibration. In order to minimize the amount of testing equipment a decision was made to utilize simple, inexpensive mechanical vibration machines which could be incorporated in the final acceptance testing sections of the production lines. The task of design and development of the quality control vibration machine was assigned to the engineering test laboratories. TAB

N68-33099# Atomic Energy Commission Research Establishment, Riso (Denmark). Electronics Dept.

FAULT DATA FOR THE PREDICTION OF RELIABILITY OF ELECTRONIC AND MECHANICAL EQUIPMENT AND SYSTEMS

P. Timmermann Feb. 1968 14 p refs

(RISO-M-709)

Some component fault rate data are given and suggested to be used as the basis for reliability predictions during the design or planning of electronic and electromechanical systems. Author (NSA)

N68-33111 British Hydromechanics Research Association, Cranfield (England).

SOME OBSERVATIONS ON THE INSTABILITY IN THE PRESSURE-VOLUME CHARACTERISTICS OF ROTODYNAMIC PUMPS

J. O. Fisher 1967 11 p Presented at the 9th Member Conf., Cranfield, Sep. 1967

(SP-914)

The difficulty of operating pumps with unstable pressure-volume characteristics, over a reasonable range is discussed together with the affect of the instability on the shape of the characteristic curve of pumps of various specific speeds. The most probable reason for the instability and the mechanism by which it is produced is described. There would appear to be some proof for the reasoning as a high specific speed pump which proved troublesome in service, due to instability in the pressure volume characteristic at maximum system head was cured by the simple addition of axial vanes in the intake bellmouth. These vanes had the affect of both reducing the intensity of the instability, and shifting it to a much higher pressure. The possible effect of the type of Vortex motion used to generate the pressure, (either by intent or accident) is reviewed and the rate of diffusion in the passages as dictated by blade loading. A free Vortex regime of pressure generation would appear to be indicated. Suction inducers are touched upon, and it is suggested that perhaps it would be better in the cause of pressure volume stability to improve suction performance by developing the blading into the eye of centrifugal pumps. Any design method, or shape which brings about the reduction of the possibility of local excess velocities in the impeller eye, would appear to have nothing but a beneficial affect on stability. Author

N68-33156# Vitro Labs., West Orange, N. J.
DEVELOPMENT OF ELECTROPHORETIC PROCESS FOR COATING T53 AIR DIFFUSER, EXHAUST DIFFUSER, AND COMBUSTION CHAMBER HOUSING WITH SERMETEL (R) W Final Report, 21 Jun. 1967–21 May 1968
Kenneth A. Gebler Jun. 1968 21 p
(Contract DAAJ01-67-C-2207)
(VL-2488-5-0; AD-671694)

Techniques were developed for electrophoretic deposition of SERMETEL W (reg. trademark) coating on the internal and external surfaces of the combustion chamber housing, air diffuser, and exhaust diffuser of the T-53 engine. There were some small areas that were found to be extremely difficult to coat due to difficulty in placing electrodes in hidden passageways. However, it is believed that the majority, if not all, of the critical surfaces were coated. TAB

N68-33227*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
INFLUENCE OF CHEMISORBED FILMS OF VARIOUS GASES ON ADHESION AND FRICTION OF TUNGSTEN IN VACUUM
Donald H. Buckley Washington Sep. 1968 25 p refs
(NASA-TN-D-4694) CFSTI: HC $3.00/MF $0.65 CSCL 11H

An investigation was conducted to determine the effect of various adsorbed gaseous species on the adhesion and friction of tungsten. Experiments were conducted in a vacuum of 10^{-10} (1.33×10^{-8} N/m^2) with a hemispherical rider specimen ((100) tungsten) contacting a flat. The atomic planes of tungsten examined on the flat included the (100), (110), and the (210). The gases adsorbed to these tungsten surfaces included hydrogen, oxygen, carbon dioxide, hydrogen sulfide, and a homologous series of hydrocarbons (methane through decane), as well as ethylene and acetylene. The results of the study indicate that the presence of any gas, even hydrogen, on the tungsten surface will reduce adhesion and friction. Less than a monolayer of oxygen adsorbed on tungsten is sufficient to reduce appreciably the friction of tungsten crystals. For hydrocarbons, an increase in chain length (methane through decane) resulted in a progressive decrease in friction. Furthermore, with ethane, ethylene, and acetylene, friction decreased with increasing bond saturation. Author

N68-33233# Oak Ridge National Lab., Tenn.
EFFECTS OF POWDER AND PROCESS VARIABLES ON THE PROPERTIES OF SINTERED ALUMINUM PRODUCTS
G. L. Copeland, M. M. Martin, D. G. Harman, and W. R. Martin May 1968 58 p refs Presented at the Intern. Conf. on Powder Technol. Sponsored by ASTM and IITRI, Chicago, 20–23 May 1968
(Contract W-7405-ENG-26)
(ORNL-TM-2215) CFSTI: $3.00/MF $0.65

A fabrication process for SAP billets is reported. Upon subsequent extrusion this material has uniform properties with strength greater than commerical SAP with equivalent oxide concentration. The optimum method of introducing the Al_2O_3 dispersoid is ball-milling atomized Al powder to flake shape with stearic acid as a surfactant. The optimum route for producing an extrusion billet is vacuum hot pressing of the milled powder followed by vacuum heat treatment of the billet immediately before extrusion. The heat treatment converts the low-temperature hydrates of alumina to a mixture of eta and chi forms of Al_2O_3, which behave stably at the expected service temperature of SAP. Removal of water and hydrogen before extrusion is necessary for thermal stability of the alloy. Inclusion of Fe up to 3 wt % and C up to 2 wt % in the form of Al_4C_3 had no significant effect on the mechanical properties of extruded rods. Author (NSA)

N68-33263# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
PRESSURES IN SEALING GROOVES OF HYDRAULIC ASSEMBLIES [O DAVLENIYAKH V UPLOTNITEL'NYKH KANAVKAKH GIDROAGREGATOV]
P. I. Blandov *In its* News of Inst. of Higher Learning Aeron. Eng., No. 1, 1966 2 Oct. 1967 p 10–20 refs (See N68-33261 20-23)

The article provides calculations of pressures in the sealing groove of hydraulic assemblies and furnishes the following conclusions: (1) high pressures in the groove promote accelerated wear of seals; seals are pulled into the clearances between fittings, impeding the flow of vapor; (2) unloading in groove causes cavitation; (3) when pressure in groove on the sliding wall is lowered, frictional forces are able to twist the ring; and (4) pump action of the sliding wall of advancing vapor can appear not only in sealing grooves, but also in any dead-end volumes filled with liquid, which are joined with the clearance. To avoid the harmful action of pump action of the wall on against change of pressures in the sealing grooves or other closed volumes it is advisable to connect the latter with the working cavity of the unit by drainage holes, which must be provided also in the protective linings, protecting sealing from pressure in the clearances. Author

N68-33306 Polytechnic Inst. of Brooklyn, N. Y.
MODELS, ANALYSIS, AND APPROXIMATIONS FOR SYSTEM RELIABILITY AND AVAILABILITY
Martin Messinger (Ph.D. Thesis) 1967 312 p
Available from Univ. Microfilms: HC $14.20/MF $4.00 Order No. 67-13408

Probabilistic models are formulated for the computation of the system reliability in terms of the component reliabilities or conditional failure rates. Emphasis is placed on obtaining bounds and approximations that can be used to simplify the necessary computation. In evaluating the usefulness of these bounds and approximations the following criteria of "goodness" are defined and used: A bound (or approximation) is judged good in the high reliability region if the percentage error in the system failure probability is small, and conversely, a bound is good in the low reliability region if the percentage error in the system reliability is small. The system structure is modeled in terms of a reliability graph. From the minimal cut sets of the reliability graph, good bounds and approximations are obtained for the high reliability region, and from the minimal tie sets, good bounds and approximations are obtained for the low reliability region. Dissert. Abstr.

N68-33314# Technische Hochschule Munchen (West Germany). Inst. fuer Fertigungstechnik A.
EFFECT AND CONTROL OF CHATTER VIBRATION IN MACHINE TOOL PROCESSES Quarterly Technical Report, 1 Aug.–31 Oct. 1967
Karl G. Mueller Dec. 1967 40 p
(Contract AF 61(052)-961)
(QTR-5; AD-671549)

From a classical mathematical model usually employed in general vibrational analysis the procedure to obtain the Multiplex-description is shown and the physical meaning of the involved mathematical derivations is given. By measurement on a medium sized vertical milling machine, it is shown as to within what range of measuring accuracy the normal mode excitation is considered to be satisfactory. For a second milling machine the Multiplex description is made by the normal mode identification technique and for four pairs of positions the mobility transfer functions are synthesized. The same transfer functions are also directly measured using relative exciter and pickup devices. The results of direct measurement and synthesis are compared and fair correlation is observed. Author (TAB)

N68-33318# Kernforschungszentrum, Karlsruhe (West Germany). Inst. Fuer Material Und Festkoerperforschung.

ISOSTATIC HOT PRESSING: A NEW COMPACTION METHOD FOR POWDER METALLURGY [ISOSTATISCHES HEISSPRESSEN: EIN NEUES VERDICHTUNGSVERFAHREN DER PULVERMETALLURGIE]

H. Bumm, F. Thuemmler, and P. Weimar Jan. 1968 23 p refs In GERMAN

(KFK-708; EUR-3717.d)

A new compaction method for powders, isostatic hot pressing, is described. The process occurs at high temperatures and pressures in an autoclave. The samples are in a thin-walled metal holder, which transfers the isostatic gas pressure to the powder and takes it to theoretical density. An installation working at 1600°C and 1000 atm was developed and tested. The physical characteristics of a hot-pressed sample of UO_2–10% Mo were measured and compared with the values taken from the literature. Author (NSA)

N68-33337 National Lending Library for Science and Technology, Boston Spa (England).

FORWARD SLIP IN THE ROLLING OF STRIP FROM METAL POWDERS

L. M. Galdar' and V. Z. Zhilkin 29 Jul. 1968 11 p refs Transl. into ENGLISH from Poroshkovaya Met., Akad. Nauk Ukr. SSR (Kiev), no. 4, Apr. 1968 p 10–14 In ENGLISH and RUSSIAN *Its* Transl. 68/207

Available from Natl. Lending Library, Boston Spa, Engl.

Experimental studies of forward slip in 17 Cr-Ni and 18Cr-16Ni stainless steels, and Sulinsk iron powders (medium and fine grades) were made and analytical expressions derived for determining the velocity of entry of powder consolidated to its tap density into rolling mill rolls. Forward slip was determined as a function of strip thickness (h_s), roll diameter (D), strip density, and powder tap density; and was characterized using both the densification coefficient and the ratio h_s/D. Results of these studies indicated that: (1) in the rolling of porous strip of constant thickness, varying the density has no marked effect on forward slip and (2) in the rolling of porous strip whose thickness and density are strongly affected by changes in rolling velocity, rolling velocity indirectly affects forward slip. S.C.W.

N68-33342 National Lending Library for Science and Technology, Boston Spa (England).

DEVELOPMENTS AND TRENDS IN PRECIOUS-METAL ELECTROPLATING, PARTS 4, 5 AND 7

H. Benninghoff 29 Jul. 1968 43 p Transl. into ENGLISH from Galvanotechnik (Germany), no. 58, 1967 p 101–108; 190–195; 338–342 *Its* Transl. No. 67/19

Available from Natl. Lending Library, Boston Spa, Engl.

Developments and trends in gold and silver electroplating and pretreatment processing techniques are discussed, and industrial applications of electrodeposited precious metals are assessed. S.C.W.

N68-33568# Defence Standards Labs., Maribyrnong (Australia).

MACHINING TOLERANCES FOR STANDARD PROPORTIONAL ROUND TEST PIECES FOR TENSILE TESTING OF METALS TO AS A23-1964

G. W. Wycherley Jun. 1968 27 p refs

(Rept.-315) CFSTI: HC $3.00/MF $0.65

Fully dimensioned test pieces for the 5.65 $\sqrt{\text{area}}$ series of proportional round test pieces for both wrought and cast metals with threaded, plain and headed ends are given. Tabulated dimensions and working drawings are presented to assist in the selection and facilitate the ordering of tensile test pieces, and to form a basis for standardization of tension loading shackles for testing machines. Author

N68-33694# Societe Belge Pour l'Industrie Nucleaire, Brussels (Belgium)

EXAMINATION OF THE INTERNATIONAL ATOMIC ENERGY AGENCY'S REGULATIONS FOR THE SAFE TRANSPORT OF RADIOACTIVE MATERIALS. STUDY OF THE BASIC ELEMENTS OF THE TYPE B PACKAGING TESTS AND OF A TYPICAL TEST STATION, VOLUME 3 Final Report

EURATOM Jun. 1968 134 p

(Contract EURATOM-024-65-6 ECIC)

(EUR-3485.e.f. V. 3) CFSTI: HC $3.00/MF $0.65

Statistics and reports on serious accidents occuring during the transport of radioactive materials or conventional goods are examined. One section is given to impact-type accidents involving various means of transport. For each means of transport, efforts are made to determine the maximum accident speed associated with a reasonable probability. The movement of deceleration versus time, or at least the maximum deceleration of the carrier vehicle, is assessed for that speed. On the basis of these data, and allowing for normal stowing as described, the damage to the actual goods transported is predetermined, according to whether they remain integral with the vehicle chassis or not. Another section deals with fire accidents; the problem of generally observed maximum temperatures, and of mean fire duration, is considered for each means of transport. The conclusions from these findings show that the nine-meter drop test and the fire test laid down in the IAEA regulations are valid as representative tests for serious accident conditions. A standard station for testing radioactive material packaging is described. Author

N68-33595# Societe Pour Les Transports de L'Industrie Nucleaire, Paris (France).

EXAMINATION OF THE INTERNATIONAL ATOMIC ENERGY AGENCY'S REGULATIONS FOR THE SAFE TRANSPORT OF RADIOACTIVE MATERIALS. REPORT ON THE IMPLICATION OF THE TEST REQUIREMENTS FOR TYPE B PACKAGING AND A STUDY OF PRACTICAL SOLUTIONS, VOLUME 4 Final Report

Brussels EURATOM Jun. 1968 325 p refs

(Contract EURATOM-024-65-6 ECIC)

(EUR-3485.e.f. V. 4) CFSTI: HC $3.00/MF $0.65

Theoretical methods, or a combination of theoretical and experimental methods, to determine the effects of the conventional accident tests to which the regulations require "B" type containers to be subjected are reported. For the heat test an overall theory is described for establishing the chart of the temperatures attained at every instant and at all points of the container. In order to meet the after-test requirements it is generally advisable to limit such temperatures. This is done by using heat resistant devices, of which several examples are given. The mechanical test has very varying effects—overall deformations, local strains, stresses in the sealing elements, and an overall theory cannot be drawn up. By a combination of theoretical approaches and systematic tests, however, a quantitative evaluation of most of these effects is provided. To comply with the requirements it will often be necessary to limit certain of these effects; in most cases this can be done by using simple economical damper hoods, the theory of which is outlined. Author

N68-33597# Nuklear-Chemie und -Metallurgie, G.M.B.H., Wolfgang Bei Hanau (West Germany).

EXAMINATION OF THE INTERNATIONAL ATOMIC ENERGY AGENCY'S REGULATIONS FOR THE SAFE TRANSPORT OF RADIOACTIVE MATERIALS. REPORT ON THE IMPLICATION OF THE SAFETY CRITERIA FOR FISSILE MATERIAL PACKAGES AND A STUDY OF PRACTICAL SOLUTIONS, VOLUME 5 Final Report

Brussels EURATOM Jun. 1968 135 p refs

(Contract Euratom-024-65-6 ECIC)

(EUR-3485.e.f. V. 5) CFSTI: HC $3.00/MF $0.65

Application of existing transport regulations on the packaging of fissile materials was studied, and some practical solutions for satisfying these regulations were investigated. Regulatory aspects were considered, beginning with the historical development of the International Atomic Energy Agency (IAEA) philosophy and recommendations. Open frame birdcages, justification for some tests, and definition of fissile class iii were considered. National and international regulations based on the IAEA recommendations are discussed. Requirements for containers for nonirradiated fissile materials were analyzed, including integrity, fire resistance, and tightness. Proposals are offered for container construction that will control deformation during accidents, give adequate fire protection, and insure tightness under accident conditions. Nuclear transport on an industrial scale is described and some container constructions are presented that conform to IAEA regulations and use the results obtained during the current study. M.W.R.

N68-33603# Cyclotron En Isotopen Laboratorium, Petten (Netherlands).
EXAMINATION OF THE INTERNATIONAL ATOMIC ENERGY AGENCY'S REGULATIONS FOR THE SAFE TRANSPORT OF RADIOACTIVE MATERIALS. STUDY OF THE BASIC ELEMENTS OF THE TYPE A PACKAGING TESTS AND PRACTICAL SUGGESTIONS FOR RADIOISOTOPE PACKING, VOLUME 2 Final Report
N. V. Philips-Duphar Brussels EURATOM Jun. 1968 77 p refs
(Contract EURATOM-024-65-6 ECIC)
(EUR-3485.e.f, V. 2) CFSTI: HC $3.00/MF $0.65

The validity of tests established by the International Atomic Energy Agency (IAEA) regulations was evaluated, and practical solutions were devised for the design and construction of type A packagings. The relevant literature and existing test methods for normal commercial products were studied with a view toward application to the transport of radioisotopes. Information and packaging materials were also solicited for evaluation purposes from a number of organizations and firms in various countries. The packaging materials were tested for quality and construction according to the IAEA regulations for safe transport of radioactive materials. As a result of this evaluation, test procedures are recommended for cardboard packagings, and two scale models are provided of packagings which satisfy the test requirements. K.W.

N68-33606 National Lending Library for Science and Technology, Boston Spa (England).
ELECTRON BEAM WELDING MACHINE ZIS 490 [ELEKTRONENSTRAHLSCHWEISSANLAGE ZIS 490]
Ulrich Heisig, Guenter Jaesch, Fritz Koch, and Peter Wiesner [1967] 11 p refs Transl. into ENGLISH from Schweisstechnik (Berlin), v. 17, no. 2, Feb. 1967 p 79-83
(M-7148) Available from Natl. Lending Library, Boston Spa, Engl.

Mechanical and welding experiments performed on a newly developed electron beam welding machine (ZIS 490) which has potential applications in turbine fabrication, the construction of vehicles, ships, and aircraft, and in electronics are described. Assessments of analyses of butt welded specimen of plain carbon steel with stainless steel and butt welded specimen of copper to stainless steel are included to demonstrate capabilities of the electron beam apparatus. S.C.W.

16 MASERS

Includes applications of masers and lasers. For basic research see: 26 Physics, Solid State.

N68-32263 Cornell Univ., Ithaca, N. Y.
A STUDY OF PHOTON LOSS IN THE ACTIVE AND PASSIVE REGIONS OF A SEMICONDUCTOR LASER
Robert George Hunsperger (Ph.D. Thesis) 1967 144 p
Available from Univ. Microfilms: HC $6.80/MF $3.00 Order No. 67-13915

Photon loss in the active and passive regions of a GaAs electron-beam-pumped laser has been measured and evaluated. A theoretical expression has been developed which gives the threshold current density required to produce lasing in an electron-beam-pumped semiconductor laser. This expression takes into consideration the fact that the laser crystal possibly may not be pumped by the beam over the entire length between Fabry-Perot surfaces, and that the photon absorption loss in the active region is different from that in the passive region. This behavior has been explained in terms of a theoretical model in which the two major photon loss mechanisms are free carrier absorption and interband absorption. In the passive region both of these mechanisms contribute to photon loss, while in the active region interband absorption is suppressed by the inverted population. The experimentally measured values of the loss coefficients have been compared with the expected values calculated according to the above theoretical model and found to be in agreement. Dissert. Abstr.

N68-32374# Naval Ordnance Lab., White Oak, Md.
TRAVEL REPORT ON THE FIRST INTERNATIONAL CONFERENCE ON LASER APPLICATIONS
Louis R. Maxwell 20 Apr. 1968 31 p refs Conf. held in Paris, 18-23 Jul. 1967
(NOLTR-68-53; AD-671866)

The First Internation Conference on Laser Applications resulted in the presentation of work covering very wide and diverse subjects, including medical applications. Some of the highlights reviewed in this report deal with mechanical alignment including shop practive, air to ground range finding, testing of materials, study of shock fronts and correcting tumor sites on eye retinas. A promising application presented is welding of oxidizing metals in air. Author (TAB)

N68-32447# Weapons Research Establishment, Salisbury (Australia).
LASER RADAR—TOWARDS THE IDEAL TRANSMITTER
W. N. Garwoli and J. L. Hughes Apr. 1968 76 p refs
(WRE-TN-PAD-146) CFSTI: HC $3.00/MF $0.65

Details of solid state laser development aimed at producing a reliable transmitter, suitable for ranging and tracking systems are presented. Work was based on experience gained during extensive field assessment of early laser ranging equipment, undertaken during 1963. The optimum characteristics of a laser transmitter are presented, together with proposals for a transmitter model approaching this ideal. Author

N68-32495# Institut fur Plasmaphysik G.M.B.H., Garching (West Germany).
INVESTIGATION OF SPECTRUM OF GIANT PULSE RUBY LASERS WITH RESPECT TO NARROW LINE WIDTH [UNTERSUCHUNG DES SPEKTRUMS VON RUBIN-RIESENPULSLASERN IM HINBLICK AUF KLEINE HALBWERTSBREITE]
L. Kellerer, D. Meisel, and H. Roehr Feb. 1968 23 p refs In GERMAN; ENGLISH summary
(IPP-1/75) CFSTI: HC $3.00/MF $0.65

It is shown that in general the spectrum of a giant pulse ruby laser consists of one or more lines. The width of the spectrum may be 0.3—0.5 Å. Using a resonant reflector and cooling the ruby to a temperature of 10° C (this temperature probably depends on the resonant reflector used) the line width always can be made < 0.1 Å. Author

N68-32584# Systems Research Labs., Inc., Dayton, Ohio.
EFFECT OF A HEATED PLATINUM WIRE ON A SEALED CARBON DIOXIDE LASER SYSTEM
F. M. Taylor, A. Lombardo, and W. C. Eppers (AF Avionics Lab.) Wright-Patterson AFB, Ohio AF Avionics Lab. Apr. 1968 18 p refs
(Contract F33615-67-C-1138)
(SRL-TR-11605; AFAL-TR-68-51; AD-671499)

A heated platinum wire was used in a sealed CO2-N2-He laser system, resulting in increases in output power that were dependent on the initial fill pressure of CO2. The system was also filled with a CO2-He mixture and made to lase. Heating of the platinum wire caused a decrease in output power. It was tentatively concluded that the platinum catalyzes the reaction CO + O to CO2, permitting a higher concentration of CO2 in a sealed system than is otherwise possible. Author (TAB)

N68-32651 Polytechnic Inst. of Brooklyn, N. Y.
AVERAGE ELECTRON ENERGIES AND DENSITIES IN THE HE-NE LASER DISCHARGES
Edward F. Labuda (Ph.D. Thesis) 1967 150 p
Available from Univ. Microfilms: HC $7.00/MF $3.00 Order No. 67-13402

In this work, the relationships between the average electron energy and density and the external parameters of the dc excited He-Ne discharge used for producing laser oscillation of the 3s and 2s → 2p and 3s → 3p transitions of Ne were experimentally determined. The average electron energy was determined by measuring the microwave noise emitted by the discharge while microwave perturbation techniques were used for determining the average electron density. The results of the average electron energy measurements are compared to calculate values obtained from a modified form of the standard ambipolar diffusion theory which is applicable to a discharge through a gas mixture. Dissert. Abstr.

N68-32652 Boston Univ., Mass. Graduate School.
NON-PERTURBATIVE SELF CONSISTENT FIELD THEORY OF GAS LASERS
Samuel Theodore Scott (Ph.D. Thesis) 1967 110 p
Available from Univ. Microfilms: HC $5.40/MF $3.00 Order No. 67-13286

In 1964 Willis showed that the quantum mechanical Liouville equation for a laser model could be expanded in powers of a small parameter $\gamma N \gamma$, where the lowest order term in the density matrix expansion reproduced the equations of the semiclassical theory. This lowest order theory is called the self consistent field approximation, or SFCA, and is the basis for the work in this thesis. Part of our work is an investigation of the dynamical and statistical approximations inherent in the SCFA and a discussion of the conditions for which the SCFA gives an accurate theory. The main work in this thesis is a non-perturbative treatment of the correlations that occur between atomic center of mass variables and operators associated with atomic internal degrees of freedom. In out treatment of the gas laser we have consistently neglected double frequency terms that come from the counter resonant part of the interaction Hamiltonian. A final section of the thesis discusses other laser problems and the possible extensions of the SFCA method. Dissert. Abstr.

N68-33279# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
QUANTUM RADIOPHYSICS (SELECTED PARTICLES)
13 Sep. 1967 83 p refs Transl. into ENGLISH from Tr. Fiz. Inst., Akad. Nauk SSSR (Moscow), v. 31, 1965 p 74–112, 139–177
(FTD-MT-67-31; AD-670120)

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2. CONDITIONS OF PULSATIONS OF EMISSION POWER OF QUANTUM GENERATORS A. N. Orayevskiy and A. V. Uspenskiy p 22–37 refs (See N68-33281 20-16)
3. QUESTIONS OF CONSTRUCTION AND INVESTIGATION OF WORK OF QUANTUM GENERATOR ON BEAM OF HYDROGEN ATOMS N. G. Basov, G. M. Strakhovskiy, A. I. Nikitin, T. F. Nikitin, V. M. Tatarenkov et al p 38–78 refs (See N68-33282 20-16)

N68-33280# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
REGENERATIVE OPTICAL QUANTUM AMPLIFIERS [REGENERATIVNYYE OPTICHESKIYE KVANTOVYYE USILITELI]
N. G. Basov, A. Z. Grasyuk, I. G. Zubarev, and L. V. Telelev *In its* Quantum Radiophys. 13 Sep. 1967 p 1–21 refs (See N68-33279 20-16)

An optical quantum amplifier is defined as a device in which coherent light emission is amplified by using the laser principle. The properties of the amplifiers and their practical utilization are discussed, along with the fundamental theoretical relations necessary for appraisal of the properties. Results of experimental investigations of certain amplifier circuits and their basic characteristics are described. Author

N68-33281# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
CONDITIONS OF PULSATIONS OF EMISSION POWER OF QUANTUM GENERATORS [REZHIM PUL'SATSIY MOSHCHNOSTI IZLUCHENIYA KVANTOVYKH GENERATOROV]
A. N. Orayevskiy and A. V. Uspenskiy *In its* Quantum Radiophys. 13 Sep. 1967 p 22–37 refs (See N68-33279 20-16)

Presently known facts concerning the random pulsations and quasicontinuous pulsation mode are reviewed, as well as theoretical hypotheses on pulsation theory. The character of the nonstationary processes in a two-level system within the framework of a single oscillation mode, and the conditions under which they arise are analyzed. A model of a substance with two relaxations times is used. The equations of the two-level laser are derived rigorously in the form of approximate velocity equations, and the applicability of the latter as well as ways of increasing their accuracy are discussed. Modes that can be reconciled with a system of equations with nondiagonal elements of the density matrix are analyzed. The transients in a two-level generator, as deduced from the equations, are briefly described. The system of equations for the case two oscillation modes are solved, and damped pulsation regimes are obtained. It is concluded that: (1) the sum of the amplitudes of the two modes execute regular damped oscillations, and the amplitude of each of them executes irregular oscillations; and (2) the amplitudes in two different modes pulsate in phase opposition. Author

N68-33282# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
QUESTIONS OF CONSTRUCTION AND INVESTIGATION OF WORK OF QUANTUM GENERATOR ON BEAM OF HYDROGEN ATOMS [VOPROSY KONSTRUKTSII I ISSLEDOVANIYE RABOTY KVANTOVOGO GENERATORA NA PUCHKE ATOMOV VODORODA]
N. G. Basov, G. M. Strakhovskiy, A. I. Nikitin, T. F. Nikitin, V. M. Tatarenkov et al *In its* Quantum Radiophys. 13 Sep. 1967 p 38–78 refs (See N68-33279 20-16)

The construction of a hydrogen beam maser and the choice of optimal parameters are described. Preliminary operating results are given using the transition ($F = 1, m_F = 0$) → ($F = 0, m_F = 0$) at the frequency 1420.405 MHz. Two installations of different construction were prepared and tested. The behavior of the quantum generator in underexcited conditions was investigated, and the characteristics of excited atoms in the retort were determined. Installations were triggered in the resonator in the presence of constant axial magnetic field. Dependence of amplitude and frequency of generation on different parameters was investigated. It is determined that the biggest contribution to instability is given by instability of additional constant magnetic field and detuning of resonator due to thermal expansion. Ways of removing these main causes of instability are outlined. Author

N68-33394# Tubingen Univ. (West Germany).
EFFECTS OF ATMOSPHERIC TURBULENCE ON THE POLARISATION OF A LASER BEAM AT 6328 Å
D. H. Hoehn *In* AGARD Advanced Tech. for Aerospace Surveillance 1968 p 13–26 refs (See N68-33392 20-14)

The turbulence-induced depolarisation of a linearly polarised laser beam was investigated experimentally, primarily with an optical path of 4.5 km. a He-Ne gas-laser at 6328 Å was used with an additional polariser at the output and with a rotating polarisation filter assembly in front of the receiver. The dependence of depolarisation on the magnitude of the intensity fluctuations was cbmpared with the theoretical predictions of Hodara[7]. In agreement with his theory, the depolarisation is so small that the polarisation of the laser without polariser (crossed-to parallel intensity ratio of about 10^{-4}) was not degraded up to path-lengths of 30 km. Author

N68-33411# Elliott Bros., Ltd., London (England).
A LASER DISPLAY SYSTEM
G. G. Fuller *In* AGARD Advanced Tech. for Aerospace Surveillance 1968 p 317–328 refs (See N68-33392 20-14)

A display system is described in which a laser beam is deflected to form a raster scan and information impressed by an amplitude (brightness) modulator. The beam can then be used to display information directly on a rear projection screen or alternatively used to write information on a photochromic slide which can be projected in the conventional manner using filtered light. Although the system is designed initially for British 405 line television standards, it is potentially capable of modification to random scan for use with computer generated alphanumeric and graphic displays. The paper gives descriptions of the video frequency amplitude modulator and the line and frame scan modulators together with details of the associated optical assembly. Also included is a brief description of the argon ion laser which has been developed for the system. Author

N68-33573*# Aztec School of Languages, Inc., Acton, Mass.
OSCILLATION MECHANISM IN CO_2 [MEKHANIZM GENERATSII NA CO_2]
N. N. Sobolev and V. V. Sokovikov, (Acad. of Sci., Moscow) Washington NASA Aug. 1968 11 p refs Transl. into ENGLISH from the book "A Survey of Phenomena in Ionized Gases" Vienna, Intern. At. Energy Agency, 1968 p 401-409
(Contract NASw-1692)
(NASA-TT-F-11884) CFSTI: HC $3.00/MF $0.65

Processes producing population inversion of the vibration modes of a CO_2 molecule in CO_2 lasers are considered. It was assumed that the main process causing upper laser level population is vibrational excitation of N_2 and CO molecules by electron impact and resonance transmission of oscillation energy to CO_2 molecules. There can be direct $00°1$ CO_2 level excitation by electrons as well, although the above-mentioned process alone can produce a pumping rate corresponding to observed values of specific oscillation power. The excitation rate of the lower laser level is described by the relaxation of the bending vibration mode. Hence, the introduction of foreign gases into the discharge tube, which increases the rate of the $01^1O_2CO_2$ level destruction, is expected to produce an increase of the inversion laser level population. Addition of helium to CO_2 leads mainly to a gas temperature drop resulting in reduced upper laser level destruction. Author

17 MATERIALS, METALLIC

Includes cermets; corrosion; physical and mechanical properties of materials; metallurgy; and applications as structural materials. For basic research see: 06 Chemistry. For related information see also: 18 Materials, Nonmetallic; and 32 Structural Mechanics.

N68-32241 Case Inst. of Tech., Cleveland, Ohio.
AN ELECTRON MICROSCOPY INVESTIGATION OF THE OMEGA PHASE IN THE ZIRCONIUM NIOBIUM SYSTEM
Paul Ellison Yaffe (Ph.D. Thesis) 1967 151 p
Available from Univ. Microfilms: HC $7.20/MF $3.00 Order No. 67-16112

The athermal and isothermal omega transformations were studies with brightfield and precision darkfield techniques in Zr-12%, 17% and 25% Nb alloys. The athermal omega was found to exist as planar precipitates consistent with $\{112\}_{bcc}$ and $\{110\}_{bcc}$ habit planes and are approximately 100Å in diameter and 20Å in thickness. The density of the athermal particle is of the order of 10^{18} particles/cc and the particles tend to align parallel to one another in $\langle 112\rangle_{bcc}$ and $\langle 110\rangle_{bcc}$ beta directions. The difference between the athermal omega reaction and the conventional martensitic reactions is emphasized and the athermal transformation is considered as a second order transformation. During the early stages of aging in the 17% alloy athermal omega forms as the specimen cools from the aging temperature resulting in mixtures of isothermal and athermal omega at room temperatures. In the 12% alloy the isothermal omega particles are initially plate-shaped with the same habit plane and alignment directions which are characteristic of the athermal omega. Dissert. Abstr.

N68-32286# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
THE EFFECT OF CERTAIN FACTORS OF PROGRAMMED LOADING ON SERVICE-LIFE OF ALUMINUM ALLOY EXPOSED TO AGGRESSIVE MEDIUM [O VLIYANII NEKOTORYK FACTOROV PROGRAMMNOGO NAGRUZHENIYA NA DOLGOVECHNOST ALYUMINIE-VOGO SPLAVA V USLOVIYAKH VOZDEISTVIYA AGRESSIVNOI]
A. V. Karlashov and A. D. Gnatyuk Nov. 1967 12 p refs Transl. into ENGLISH from Fiz.-Khim. Mekhan. Materialov (Ukraine), v. 2, no. 3, 1966 p 285–290
(FTD-MT-24-311-67; AD-671953)

The article describes the experimental findings on the effect of certain factors of dynamic loading on the service life of the D16T aluminum alloy (4.0% Cu, 1.29% Mg, 0.76% Mn, 0.3% Fe, 0.19% Si) exposed to the air as well as to a corrosive medium (3% NaCl) simulating the action of sea water, and subjected to various loading programs (loads of 20-15 kg/mm2 in air and 13.5-7.5 kg/mm2 in 3% NaCl solution, i.e., overloads). These programs are of the sawtooth kind, representing a sequence of alternately increasing and decreasing loading levels. Author (TAB)

N68-32298# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
OXIDATION OF COPPER AT 200–900° C

Hsun Li and Chi-Hsun Lo Sep. 1967 20 p refs Transl. into ENGLISH from Chin Shu Hsueh Pao (Peking), v. 8, no. 3, 1965 p 311–317
(FTD-HT-67-89; AD-671649)

An investigation on the oxidation of copper under an oxygen pressure of 76 mm Hg at 200-900 degrees C has been carried out. The different oxidation behaviors of copper at the different temperatures as observed are discussed in the light of surface morphology and gross defects such as cracks and cavities which may be present in the oxide layer. Moreover, on the assumption of Franks mechanism of whisker growth, an explanation of the possibility of the presence of imperfectly structured CuO whiskers is given. Author (TAB)

N68-32340 Lehigh Univ., Bethlehem, Pa.
THE EFFECT OF SUBSTITUTIONAL ALLOYING ELEMENTS ON THE ELEVATED TEMPERATURE MECHANICAL PROPERTIES OF ALPHA IRON
John Joseph de Barbadillo, II (Ph.D. Thesis) 1967 115 p
Available from Univ. Microfilms: HC $5.60/MF $3.00 Order No. 67-14932

The elevated temperature mechanical properties of alloys of alpha iron containing 1.5 atomic percent nickel, silicon, manganese, chromium, or molybdenum in solution have been investigated. Constant and differential strain rate tensile tests as well as constant load and constant stress creep tests were used in this analysis. Optical and electron microscopy were employed to correlate microstructural features with mechanical behavior. It was established that the principal role of substitutional alloying elements is to retard dynamic recovery processes which otherwise rapidly diminish the flow stress of alpha iron above 600°F. The magnitude of this effect is related to the strength of interaction between substitutional solutes and residual interstitial elements. In this respect nickel and silicon were found to contribute little to the creep resistance of iron above 600°F while manganese, chromium, and molybdenum in order of increasing effectiveness retard recovery, thereby increasing the creep strength. In iron-molybdenum alloys an actual secondary peak of flow stress occurs between 1000°F and 1200°F. Dissert. Abstr.

N68-32344 Pennsylvania Univ., Philadelphia.
THE ATTACK OF STEEL BY HYDROGEN AT HIGH TEMPERATURE AND HIGH PRESSURE
Henry Herman Gunther (Ph.D. Thesis) 1967 225 p
Available from Univ. Microfilms: HC $10.15/MF $3.00 Order No. 67-12748

The rates of attack of SAE 1095, 1045, and 1018 steels by hydrogen at temperatures 752°, 932°, and 1112° F, and pressures of 2,500 to 10,000 psig were measured. The influence of time, temperature, pressure, microstructure, heat treatment, specimen purity, and specimen geometry were investigated in order to elucidate the mechanism of attack. The criterion of attack was the extent of decarburization of the steel. Attack in the 1095 and 1045 steels was characterized by a core of unattacked steel separated from a fissured zone of carbon-depleted alpha-iron by a well defined carbon gradient. The attack of the 1018 steel was characterized by essentially simultaneous attack throughout the specimen. An extensive induction period was encountered at 752°F. The extent of attack for the 1018 steel did not vary with pressure over the range 2,500 to 10,000 psig at 932°F. Steels with spheroidized carbides were less rapidly decarburized than steels with pearlitic microstructures exposed to hydrogen at the same test conditions. Dissert. Abstr.

N68-32397# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
MECHANICAL WORKING OF LIGHT ALLOYS
A. I. Kolpashnikova 16 Jun. 1967 209 p ref Transl. into ENGLISH from Aviats. Inst., Tr. (Moscow), no. 62, 1965 p 5–177
(FTJ-MT-66-83; AD-671575)

Currently some organizations can accomplish with a fair degree of success the hot stamping of non-intricately shaped sintered aluminum powder blanks. This stamping, however, involves a number of difficulties owing to the low plasticity margin of the material. In this connection, the authors present the findings of an experimental study of the deformability of SAP by hot stamping. The following experiments were performed: free drop forging, hot stamping in open dies, hot stamping in closed dies, high-temperature stamping. Author (TAB)

N68-32419 National Lending Library for Science and Technology, Boston Spa (England).
INFLUENCE OF THE MECHANISM OF ACTION OF COMPRESSED AIR (GAS) ON THE ATOMIZATION OF A STREAM OF MOLTEN METAL
Y. A. Gratsianov and B. N. Putimtsev May 1968 14 p refs Transl. into ENGLISH from Pretsiz. Splavy, Tsentr. Nauch.-Issled. Inst. Chernoi Met., no. 51, 1967 p 189–195
(Trans-68/127) Available from Natl. Lending Library, Boston Spa, Engl.

A study has been carried out of the atomization of molten iron and iron-nickel alloys by compressed air and nitrogen. It was established that the mechanism of action of compressed gas on the character of disintegration of a molten-metal jet markedly depends on blast pressure, but is virtually independent of the form of blast. It was found that, at low blast pressures, fine particles are formed mainly from the surface layers of metal; with increasing blast pressure, a more uniform dispersion of the whole metal volume is observed. Raising the blast pressure and rate of flow increases the yield of fine powder fractions and promotes the preparation of particles having a high apparent density and the required chemical composition. The best results are obtained when compressed nitrogen is used for the atomization of metallic melts. The results of this investigation have been utilized in the development of a process for the production of ferromagnetic powders having a strictly predetermined chemical composition and high fabricating and magnetic properties (powders for electromagnetic powder clutches, pressed magnetic cores, magnetic powder materials, etc.). Author

N68-32486 National Lending Library for Science and Technology, Boston Spa (England).
INFLUENCE OF RESIDUAL AUSTENITE ON THE STRENGTH OF CASE-HARDENED SPECIMENS UNDER CONDITIONS OF FLUCTUATING STRESS [UEBER DEN EINFIUS VON RESTAUSTENIT AUF DAS FESTIGKEITSVERHALTEN EINSATZGEHAERTETER PROBEKOERPER BEI SCHWINGENDER BEANSPRUCHUNG]
C. Rezim Mar. 1968 39 p Transl. into ENGLISH from Harterei-Tech.-Mitt., 1968
(TRANS-68/67) Available from Natl. Lending Library, Boston Spa, Engl.

The investigation of residual austenite-containing specimens of case-hardened steel 14 NiCr 14 confirmed that fatigue strength will be significantly above the level of the residual austenite-free martensitic variant if the specimen undergoes mechanical strengthening in the highly stressed regions prior to stressing. Structure investigations have confirmed that during stress application, martensite transformation appears to proceed preferably in the vicinity of the surface. Author

N68-32518# Martin Co., Baltimore, Md. Research Inst. for Advanced Studies.
STRESS CORROSION CRACKING OF TITANIUM AND Ti-Al ALLOYS IN METHANOL-IODINE SOLUTIONS Special Interim Technical Report No. 1

A. J. Sedriks, J. A. S. Green and P. W. Slattery Mar. 1968 20 p refs Presented at Intern. Conf. on Titanium, London, 21–24 May 1968
(Contract DAAG-46-67-C-0138)
(RIAS-TR-68-4C; AD-671680)

Studies of the mechanical behavior of unalloyed titanium in methanol-halogen solutions have led to the suggestion that stress-corrosion cracking (SCC) in these environments occurs by localized anodic dissolution at the crack tip. The validity and generality of this model for SCC has been examined by means of comparative studies of the corrosion characteristics and susceptibility to SCC of pure titanium and Ti-Al binary alloys in methanol-iodine solutions. Evidence is presented which indicates that two distinct SCC mechanisms may be operative, namely (i) stress accelerated intergranular corrosion involving dissolution of metal at a crack tip, and (ii) a transgranular cracking process which has the characteristics of mechanical failure. The characteristics of SCC failures of pure titanium and the Ti-2.1 w/o Al alloy appear to be consistent with the dissolution model. In the higher alloys (>5 w/o Al), however, dissolution appears to be responsible only for the crack initiation stage, propagation involving transgranular cracking. Stress-corrosion failure in the higher alloys may therefore be prevented by inhibiting the initiation process via cathodic polarization or the introduction of passivators (i.e. water) into the testing environment. Author (TAB)

N68-32555 National Lending Library for Science and Technology, Boston Spa (England).
COMPARISON OF THE PROPERTIES OF BULK AND POWDER PLATINUM RUTHENIUM ELECTRODES
V. S. Entina and O. A. Petrii 6 Jun. 1968 4 p refs Transl. into ENGLISH from Electrokhim. (USSR), v. 4, no. 1, Jan. 1968 p 111–114 In RUSSIAN and ENGLISH *Its* Transl. 68/91
Available from Natl. Lending Library, Boston Spa, Engl.

Bulk Pt-Ru alloys containing 10, 20, 30 and 40 wt.% ruthenium were produced by melting, in an electric furnace in a helium atmosphere, Pt and Ru powders taken in the required proportions and pressed into tablets. The Pt and Ru employed were of 99.96% and 99.87% purity, respectively, the impurities consisting mainly of other platinum-group metals. The resulting alloys were homogenized for 3 hr in a vacuum furnace at 1400–1600°C (depending on alloy composition). "Electrolytically-mixed deposits" (e.m.d.) of Pt and Ru were produced. Powder Pt + Ru catalysts were precipitated from H_2PtCl_6 and $H_2[Ru(NO)Cl_5]$ solutions by means of sodium boron hydride. Measurements were conducted at 20 ± 2°C in 1 N H_2SO_4. The potentials ϕ_r have been reduced relative to the reversible hydrogen electrode in the same solution. Author

N68-32560 National Lending Library for Science and Technology, Boston Spa (England).
STUDIES OF THE RELATIONSHIP BETWEEN FATIGUE STRENGTH AND INTERNAL STRESS DISTRIBUTION IN CASE-HARDENED STEEL [UNTERSUCHUNGEN ZUM ZUSAMMENHANG ZWISCHEN BIEGESCHWINGFESTIGKEIT UND EIGENSPANNUNGSVERTAILUNG EINSATZGEHAERTER STAEHLE]
K. Hammer 10 Oct. 1967 8 p refs Transl. into ENGLISH from Harterei-Techn. Mitt. (West Germany), no. 22, 1967 p 160–164 *Its* Transl. 67/258
Available from Natl. Lending Library, Boston Spa, Engl.

The present research proposed to establish a relationship between rotating-beam fatigue strength of case-hardened steels and internal stress distribution. From various hypotheses of mechanics relating to fatigue fracture, it was found that shear stresses control crack nucleation and tensile stresses crack propagation. These conditions could be utilised for continuum mechanics calculations by superimposing applied and internal stresses in the form of normal or shear stresses. Under conditions of fatigue endurance the resulting stresses must have the same value as the dynamic reference strength. Tests on case-hardened specimens of K 13 NiCr 12 and 0 15 steels established that the hypothetical reference stresses were little suited to describe the improvement in fatigue strength due to surface-hardening. On the other hand, under conditions of rotating beam stressing, the maximum shear stresses lying in the plane of axial and tangential stresses corresponded approximately to the push-pull fatigue strength of the weakest structural constituent present at this point. It follows that push-pull fatigue strength as a function of distance from the surface, is the primary factor controlling the rotating-beam fatigue strength of case-hardened components. Author

N68-32567 National Lending Library for Science and Technology, Boston Spa (England).
THE INFLUENCE OF STRUCTURE ON HARDNESS AND DUCTILITY OF CONSTRUCTIONAL STEELS [DER EINFLUSS DER GEFUEGEAUSBILDUNG AUF DIE HAERTE UND DAS ZAEHIGKEITSVERHALTEN VON BAUSTAEHLEN]
Alois Legat and Alfred Moser 29 Jul. 1968 12 p refs Transl. into ENGLISH from Haerterei-Tech. Mitt. (Freiburg), v. 23, 1968 p 10–14 In ENGLISH and GERMAN *Its* Transl. 68/143
Available from Natl. Lending Library, Boston Spa, Engl.

The authors' own investigations have confirmed that a relationship between carbon content and hardness exists only for martensitic steels. Up to carbon contents of approximately 0.7% a linear increase in hardness was observed. As carbon contents in excess of 0.7% there is a marked drop in the rate of increase in hardness. No effect on maximum hardness by alloying additions such as are normally encountered in constructional steels was observed. In steels which are not fully martensitic hardness is determined, not solely by the carbon content, but is significantly affected by participation of alloying additions which control the nature and amount of mixed structures. For mixed structures containing 50% of martensite, these structural relationships were clearly confirmed. The influence of structure on ductility was studied and confirmed that in presence of ferrite, in addition to martensite, optimum ductility properties after quenching cannot be expected. In pure martensite-bainite structures the decrease in ductility is however small as proportion of bainite increases. Author

N68-32569# College of Aeronautics, Cranfield (England).
THE WELD HEAT AFFECTED ZONE STRUCTURE AND PROPERTIES OF TWO MILD STEELS
E. Smith, M. D. Coward, and R. L. Apps Jan. 1968 44 p refs
(COA-MAT-2) CFSTI: HC $3.00/MF $0.65

The visible weld heat affected zone (HAZ) of mild steel is shown to be made up of four distinct regions (a) the region of grain coarsening, (b) the region of grain refinement, (c) the partially transformed region, and (d) the region of spheroidisation. Reproduction of these HAZ structures in un-notched Charpy specimens, 1.0 cm. square and 7.5 cm. long, has been achieved using a controlled resistance heating apparatus capable of cycling specimens through thermal cycles measured in the actual HAZ of a submerged arc bead-on-plate weld in 1 1/2" thick plate using a heat input of 108 kilojoules/inch. Metallurgical examination and hardness measurements on two different mild steels have shown that the simulated regions are comparable with the actual regions in the weld HAZ. The mechanical properties of the simulated HAZ regions have been measured and correlated with the metallurgical microstructures as determined by means of optical and electron microscopy. The results show that a marked embrittlement occurs in both steels in the region of grain coarsening. A silicon killed steel to BS1501-161 Grade B is shown to be embrittled in all regions experiencing a peak temperature above to Ac_1 Author

N68-32572 National Lending Library for Science and Technology, Boston Spa (England).
THEORETICAL STUDY OF THE MECHANICAL PROPERTIES OF SINTERED STEELS [ETUDE THEORIQUE DES PROPRIETES MECHANIQUES DES ACIERS FRITTES]
M. Eudier 29 Jul. 1968 20 p Transl. into ENGLISH from GERMAN In ENGLISH and GERMAN Presented at the 2nd European Symp. on Powder Met. (Stuttgart), 1968 p 9 *Its* Trans. 68/190
Available from Natl. Lending Library, Boston Spa, Engl.

Mechanical properties of sintered metals which are simple functions of the porosity are summarized. Especially the theoretical determination of the tensile strength of porous metals and of the conditions which are necessary to obtain a minimum elongation makes possible the determination of the maximum tensile strength of all the family of low alloy steels. As a result a method of control can be obtained. Other mechanical properties, modulus of electicity, hardness, damping capacity and fatigue resistance are also considered. Author

N68-32575 Rensselaer Polytechnic Inst., Troy, N. Y.
THE MECHANISM OF HEAT-AFFECTED-ZONE HOT CRACKING IN 18-Ni MARAGING STEEL
Joseph J. Pepe (Ph.D. Thesis) 1968 106 p
Available from Univ. Microfilms: HC $5.40/MF $3.00 Order No. 67-9295

Three possible mechanisms to account for microsegregation observed in the weld heat-affected-zone have been rigorously treated on theoretical grounds and presented in the THEORY section of the present investigation. In order to establish the most probable mechanism or mechanisms, a series of experiments were conducted using 18-Ni Maraging steel. Thus, the relationship between hot cracking and alloy segregation could be readily observed metallographically. The location and morphology of the heat-affected-zone hot cracks found in commercial weldments of 18-Ni Maraging Steel were duplicated in laboratory specimens by means of the Vare-straint test. The heat-affected-zone hot cracks observed in both the commercial weldments and the laboratory specimens were located in solute-rich heat-affected-zone grain boundaries near the weld fusion line. Since most metallurgical reactions are activated processes, an investigation was conducted to determine interrelated effects of time and temperature on heat-affected-zone microsegregation. To vary the thermal cycles experienced by the weld heat-affected-zone, weldments were prepared using various commercial welding techniques. Dissert. Abstr.

N68-32579 National Lending Library for Science and Technology, Boston Spa (England).
NONUNIFORMITY OF TITANIUM DISTRIBUTION IN A NICKEL-TITANIUM STEEL
A. G. Yakhontov, A. M. Zherdev, and Z. A. Samoilenko 10 Oct. 1967 5 p refs Transl. into ENGLISH from the book "Svoistva i Primem. Zharoproch. Splavov" Moscow, Izd. AN SSSR, 1966 p 209-212 In RUSSIAN and ENGLISH *Its* Transl. 67/233
Available from Natl. Lending Library, Boston Spa, Engl.

The titanium distribution was investigated in austenitic, low carbon, 27Ni-Ti alloy and 0.1C-9Ni-Ti steel. The metals underwent ageing in α- and γ- conditions and high temperature annealing. The precipitation processes were found to have little influence on the chemical composition of fracture surfaces. High temperature annealing was found to have a marked influence at temperatures of 1100° C or greater. Fracture surfaces of alloys quenched from these temperatures or greater showed increased Ti concentration. N.E.N.

N68-32588 National Lending Library for Science and Technology, Boston Spa (England).
INCREASING THE RELIABILITY OF AUSTENITIC STEEL SUPERHEATERS
V. N. Gulyayev, N. D. Lebedeva, and G. N. Mikheyev 13 May 1968 10 p refs Transl. into ENGLISH from Elektr. St. (Moscow), v. 37, no. 4, Apr. 1966 p 25-28
(CE-TRANS-4745) Available from Natl. Lending Library, Boston Spa, Engl.

Damage associated with local plastic deformation during work-hardening of austenitic steels for superheaters is reported, along with the lower heat resistance and plasticity of the steels. A case is reported in which creep strength after 100,000 hr was reduced four-fold at 580° C and three-fold at 650° C. Heat treatment after aging is considered; and tubing of 32 mm dia, 5.5 mm wall thickness, and 220 mm length was studied. The tube was made of a steel containing 17.38% Cr, 10.72% Ni, 1.1% Mn, and less than 1% each of C, Si, and Ti. M.W.R.

N68-32590 National Lending Library for Science and Technology, Boston Spa (England).
FACTORS BEARING ON MATERIAL PROPERTIES DURING WELDING OF HEAT-RESISTANT PRECIPITATION-HARDENING NICKEL-CHROMIUM ALLOYS [WERKSTOFFBEEINFLUSSUNG BEIM SCHWFISSEN WARMFESTER, AUSSCHEIDUNGSHAERTENDER NICKEL-CHROM-LEGIERGUNGEN]
H. Hinzpeter 29 Jul. 1968 28 p refs Transl. into ENGLISH from ZIS (Zentralinst. Schweisstech.)-Mitt. (Halle), v. 10, 1968 p 124-142 In ENGLISH and GERMAN *Its* Transl. 68/132
Available from Natl. Lending Library, Boston Spa, Engl.

On welding of age-hardening nickel chromium alloys, properties of the material are subject to a detrimental influence as a consequence of the heat input in the weld heat-affected zone of welded joints. The present experimental results underline the requirements to apply a post weld heat treatment to welded joints in this type of material. The post weld heat treatment is found to be necessary, independent of the state of treatment of the alloy prior to welding. However, the manner in which this post-weld heat-treatment is applied depends on the initial state of the alloy prior to welding, the welding technique used and the thickness of the part processed. Author

N68-32639# Aerojet-General Corp., Secramento, Calif. Materials Research Lab.
TERNARY PHASE EQUILIBRIA IN TRANSITION METAL-BORON-CARBON-SILICON SYSTEMS. PART 1. BINARY SYSTEMS. VOLUME 14. CONSTITUTION OF THE HAFNIUM-VANADIUM AND HAFNIUM-CHROMIUM SYSTEMS
E. Rudy and St. Windisch May 1968 32 p refs
(Contract AF 33(615)-1249)
(AFML-TR-65-2-Pt. 1, V. 14; AD-671973)

The binary systems hafnium-vanadium and hafnium-chromium were investigated by means of X-ray, melting point, DTA, and metallographic techniques. Phase diagrams of both systems from approximately 1100C through the melting range were established. Author (TAB)

N68-32648 Purdue Univ., Lafayette, Ind.
ELECTRONIC SPECTRA OF IMPERFECTIONS IN SILICON AND SILICON-GERMANIUM ALLOY
Aare Onton (Ph.D. Thesis) 1967 181 p
Available from Univ. Microfilms: HC $8.40/MF $3.00 Order No. 67-16695

Reported are excitation spectra associated with the group III acceptor impurities boron, aluminum, gallium, and indium in silicon, the group V donor impurity bismuth in silicon, and the donor

impurities phosphorus and lithium in silicon-germanium alloy which were studied at low temperatures using high resolution grating spectrometers. The piezospectroscopic technique, together with polarized radiation were used. The improved resolution employed in the present investigations of the zero stress spectra of the group III impurities has revealed details not reported previously. The symmetries of many states associated with the transitions of both the $p_{3/2}$ and $p_{1/2}$ series have been deduced from piezospectroscopic effects. The excitation spectrum of bismuth donor in silicon has been measured under experimental conditions superior to those used by previous workers. The excitation spectra of donors in an alloy of silicon and germanium is discussed in terms of its band structure. A preliminary investigation of the donor spectra of phosphorus and lithium-oxygen complex in Si-Ge alloys has been carried out.
Dissert. Abstr.

N68-32672 National Lending Library for Science and Technology, Boston Spa (England).
INTERMETALLIC COMPOUNDS—A NEW BASE FOR HEAT-RESISTING MATERIALS
I. I. Kornilov 23 Apr. 1968 13 p refs Transl. into ENGLISH from Metalloved i Term. Obrabotka Metal. (Moscow), no. 11, Nov. 1967 p 3–12 In ENGLISH and RUSSIAN *Its* Transl. 68/73
Available from Natl. Lending Library, Boston Spa, Engl.

A discussion of the physico-chemical properties, structural characteristics, and ductility of the following intermetallic compounds is presented: (1) the heat resisting compounds Ni_3Al and NiAl, (2) the ductile intermetallic compound TiNi in the equilibrium system Ni-Ti, (3) the heat resisting titanium aluminide Ti_3Al, and (4) the heat resisting beryllides of transition metals. Based on specific studies of the ductility of the systems Ni-Al, Ni-Ti, Ti-Al, and beryllides; and literature on the characteristic properties of intermetallic compounds, it is concluded that: (1) intermetallic compounds are potentially useful as heat resisting materials; (2) many intermetallic compounds exhibit high heat resistance and corrosion resistance in aggressive media, and may therefore be employed as protective coatings for metals and alloys which readily oxidize on heating; (3) by producing intermetallic compound solid solutions and alloys of various compositions based on these solid solutions with disperse precipitates, it is possible to increase the strength and heat resistance of these materials; (4) intermetallic compounds are capable of reacting with each other and regularities of formation of solid solutions of intermetallic compounds and compounds of complex compositions have been established; (5) intermetallic compounds having ductility properties enabling them to be hot and cold deformed have been discovered among these being Ni_3Al, NiTi, Ti_3Al, and TiAg; and (6) intermetallic compounds and alloys based on them may be used for formulating heat and oxidation resistant materials.
S.C.W.

N68-32673 National Lending Library for Science and Technology, Boston Spa (England).
SHORT-TIME STRENGTH OF PLATINUM, PALLADIUM AND THEIR ALLOYS AT 1100–1400° C
E. I. Rytvin, V. M. Kuz'min, and A. E. Petrova 10 Oct. 1967 2 p Transl. into ENGLISH from Metalloved. i. Term. Obrabotka Metal. (Moscow), no. 4, Apr. 1967 p 58–59 In ENGLISH and RUSSIAN *Its* Transl. 67/295
Available from Natl. Lending Library, Boston Spa, Engl.

To determine the practical range for using platinum, palladium, and their alloys at high temperatures, studies were made of the mechanical properties of wire specimens at 1100, 1200, 1300, and 1400° C. Tensile strength and elongation values for each alloy were determined, and the microhardness of each specimen was studied after annealing for 3 hr at 1300° C. On the basis of results obtained, less expensive and more readily available alloys of the systems palladium-rhodium and platinum-rhodium-palladium whose mechanical properties at 1000 to 1400° C approach those of platinum-rhodium alloys are recommended for practical use at high temperatures.
S.C.W.

N68-32674 National Lending Library for Science and Technology, Boston Spa (England).
COEFFICIENT OF THERMAL EXPANSION OF CONSTRUCTIONAL MATERIALS AT LOW TEMPERATURES
A. K. Belov 29 Jul. 1968 5 p Transl. into ENGLISH from Metalloved. i Term. Obrabotka Metal. (Moscow), no. 4, Apr. 1968 p 20–22 In RUSSIAN and ENGLISH *Its* Transl. 68/217
Available from Natl. Lending Library, Boston Spa, Engl.

A study designed to determine the coefficient of thermal expansion at low temperatures (to −196 C) for steels and alloys in common use in the oxygen industry is reported. Materials investigated included austenitic and pearlitic steels; aluminum alloys; copperbase alloys; bronzes; and brasses. Calculated values denoting the influence of temperature on coefficients of thermal expansion $\alpha \times 10^6$ (1/deg C) of steels, aluminum alloys, and copper alloys; and integral values of the coefficient of thermal expansion for all of the materials investigated at various temperatures are tabulated. It was established that: (1) for steels of the austenitic class, the coefficient of thermal expansion ranges from $3–6 \times 10^{-6}$ 1/deg C at −196° C to $15.5–16.5 \times 10^{-6}$ 1/deg C at +20° C; (2) the coefficients of thermal expansion of pearlitic steels are lower than that of austenitic steels; (3) the coefficients of thermal expansion of aluminum alloys are much higher than those of steels and raising the temperature from −196 to −50° C approximately doubles the value of α; (4) copper-base alloys at the temperature investigated have high coefficients α, which are less temperature dependent than those of austenitic steels and aluminum alloys; (5) the coefficient of thermal expansion of bronzes is approximately the same as for pure copper; and (6) compared with bronzes, brasses have higher coefficients of thermal expansion which are more strongly affected by temperature changes.
S.C.W.

N68-32675 National Lending Library for Science and Technology, Boston Spa (England).
DEVELOPMENT OF DISLOCATION STRUCTURE IN THE SURFACE LAYERS OF METALS UNDER SOME TYPES OF LOAD
B. I. Kostetskii and V. V. Shevelya 29 Jul. 1968 9 p refs Transl. into ENGLISH from Dokl. Akad. Nauk SSSR (Moscow), v. 176, no. 1, 1967 p 70–72 In ENGLISH and RUSSIAN *Its* Transl. 68/157
Available from Natl. Lending Library, Boston Spa, Engl.

The distribution of dislocations in 18/9/Ti stainless steel after static and prolonged cyclic loading was studied using transmission electron microscopic techniques to determine (1) the character of fine structure formation in metals during fatigue, and (2) to test the validity of the hypothesis that the preferential failure of surface layers during fatigue is primarily due, not to the distribution of stresses over the cross section during prolonged alternating deformation, but to the specific condition of the free surface in contact with the external environment. Dislocation structures were examined after various degrees (1% to 15%) of uni-axial extension and after fatigue loading by symmetrical bending and repeated extension. Studies of dislocation structures within the specimen and near their surface demonstrated that with the degrees of static uniaxial deformation selected, the character of distribution and density of dislocations over the specimen cross section were almost identical. To study the characteristics of dislocation distribution in fatigue (bending), an examination was made of specimen zones in the pre-rupture condition or regions directly adjoining the fatigue fracture. It was found that even if dislocation processes analogous to those encountered in static loading do occur within the material, they correspond to a very low degree of strengthening. On the basis of these studies it is concluded that in prolonged alternating

loading, when relatively low stresses are operative (compared with static loading), the preponderant effect of sub-surface sources manifests itself more strongly. S.C.W.

N68-32677 National Lending Library for Science and Technology, Boston Spa (England).
CORROSION RESISTANCE OF NICKEL-COPPER-CHROMIUM CAST IRON
I. N. Yukalov, V. K. Fedorov, and N. A. Frolov 29 Jul. 1968 5 p refs Transl. into ENGLISH from Liteinoi Proizv. (Moscow), no. 1, Jan. 1968 p 7–8 In ENGLISH and RUSSIAN *Its* Transl. 68/159
Available from Natl. Lending Library, Boston Spa, Engl.

The effects of melting and pouring conditions; and Cr, spheroidal graphite, and Mn alloying components on the mechanical and corrosion properties of cast iron was studied in a high frequency furnace at several specific heats. Increasing the amount of chromium raised the strength characteristics, corrosion resistance, hardness, and brittleness of cast iron, but adversely affected its casting properties. For chemical-engineering purposes, Ni-Cu-Cr cast irons with 1.5–3.0% Cr are recommended since such cast irons have high strength and corrosion resistance and are easy to machine. To obtain spheroidal graphite iron had a tensile strength of about 40 kg/mm^2 and a bending deflection of about 3 mm, but the anticipated improvement in corrosion resistance was not observed. Cementite adversely affected the processing and casting properties of cast iron and high alloy carbides did not readily decompose during the annealing of castings. To prevent the formation of cementite, it is recommended that an appropriate amount of the Mg or Ce addition be selected and that the cast iron be re-inoculated with Si 75 ferrosilicon. It was established that the presence of more than 1.5% manganese increased the amount of cementite in cast iron and lowers its corrosion resistance in sulphuric acid, therefore replacing Ni by Mn in Ni-Cu-Cr cast iron is not recommended. Cast iron poured at higher temperatures was more corrosion resistant in many technological media than cast iron overheated and poured at low temperatures. S.C.W.

N68-32679 National Lending Library for Science and Technology, Boston Spa (England).
FATIGUE STUDIES ON THE HIGH-STRENGTH STEEL 35 NCD 16 (AFNOR) [DAUERFESTIGKEITSUNTERSUCHUNGEN AN DEM HOCHFESTEN STAHL 35 NCD 16 ("AFNOR")]
G. Ledoux 29 Jul. 1968 18 p Transl. into ENGLISH from Haerterie-Tech. Mitt. (Freiburg), v. 23, 1968 p 14–21 In ENGLISH and GERMAN *Its* Transl. 68/144
Available from Natl. Lending Library, Boston Spa, Engl.

In an attempt to find a solution to fabricating difficulties encountered during the application of high strength steels for under-carriage components of large dimensions and complex shape the following were investigated: (1) the influence of cooling rate on quenching, supercooling after quenching, and atmosphere of the austenitising furnace on fatigue strength of high strength, air hardening steels (35 NCD 16); and (2) the influence of different surface treatments, e.g., fine grinding, electrolytic polishing, and shot-peening on fatigue strength. Results indicate that: (1) during heat treatment of 35 NDC 16 steel, supercooling is advantageous and should consequently be retained; (2) heat treatment in a vacuum furnace affords optimum results, particularly under conditions where, in the light of appreciable dimensions of components, the cooling rates must be raised over those normally adopted for cooling in stationary air; (3) electrolytic polishing has a particularly beneficial effect on finishing-machining, since sharp microscratches are removed by such a treatment; (4) in all instances fatigue strength is significantly raised by shot-peening, although defects cannot always be remedied by such treatment; and (5) the purity of the steel, which depends on the conditions of melting, exerts a significant effect on fatigue strength. S.C.W.

N68-32687 National Lending Library for Science and Technology, Boston Spa (England).
HAFNIUM-NICKEL PHASE DIAGRAM
V. N. Svechnikov, A. K. Shurin, and G. P. Dmitrieva 6 Jun. 1968 8 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Metally (Moscow), no. 6, Nov.–Dec. 1967 p 176–179 In ENGLISH and RUSSIAN *Its* Transl. 68/92
Available from Natl. Lending Library, Boston Spa, Engl.

Using the methods of thermal, metallographic, and X-ray diffraction analyses, the phase diagram of the system Hf–Ni was constructed. The existence of eight intermetallic compounds was confirmed. These are: Hf_2Ni, HfNi, Hf_9Ni_{11}, Hf_2Ni_3, Hf_2Ni_5, $HfNi_3$, Hf_2Ni_7 and HfNi $_5$—in the system Hf-Ni. The temperatures and conditions of formation of these intermetallic compounds were determined. A reversible transformation in the intermetallic compound HfNi, apparently linked with polymorphism, was discovered at a temperature of 1170°C. The addition of nickel lowers the temperature of the polymorphic transformation in hafnium to 1250°C. The solubility of nickel in hafnium is less than 1 at.% at a temperature of 1250°C, while the solubility of hafnium in nickel is 1 at.% at a temperature of 1050°C. Author

N68-32702 National Lending Library for Science and Technology, Boston Spa (England).
EFFECT OF THE PROPERTIES OF GALVANIC COATINGS WHEN MEASURING THEIR THICKNESS WITH HIGH-FREQUENCY ELECTROMAGNETIC INSTRUMENTS [VLIYANIE SVOISTV GAL'VANICHESKIKH POKRITII NA IZMERENIE IKH TOLSHCHINY VYSOKOCHASTOTNYMI ELEKTROMAGNITNYMI PRIBORAMI]
Yu. Grigulis and Z. Khubaeva May 1968 12 p refs Transl. into ENGLISH from Latvijas PSR Zinatnu Akad. Vestis (Riga), no. 10, 1963 p 33–40
(RTS-4528) Available from Natl. Lending Library, Boston Spa, Engl.: 20s

Various experiments were conducted to determine the effects of non-constancy in the properties of galvanic coatings on the readings of high-frequency instruments, and to determine a method of correction when inspecting the thickness of the coatings using these instruments. The experimental work was performed with attention focused on copper, zinc, nickel and chromium coatings. Using the relationships obtained, it was possible to determine how the basic electrolysis parameters affect the properties of the coatings. Among the results, it was concluded that (1) variation in current density, temperature and acidity within the limits permitted the technological conditions for a given type of coating has no effect on the instrument readings, and (2) the use of different electrolytes to produce monotypic coatings has practically no effect on the instrument readings. B.S.D.

N68-32726 National Lending Library for Science and Technology, Boston Spa (England).
INFLUENCE OF HIGH PRESSURE ON THE DUCTILITY AND FRACTURE OF METALS [VLIYANIE VYSOKOGO DAVLENIYA NA PLASTICHNOST' I RAZRUSHENIE METALLOV]
E. D. Martynov Apr. 1968 25 p refs Transl. into ENGLISH from the book "Vsb. Mek. Plast. Deformatsii Met." Kiev, Izd. Naukova Dumka, 1965 p 4–28
(RTS-4509) Available from Natl. Lending Library, Boston Spa, Engl.: 40s

Maximum ductility curves of metals were examined for pressure mechanism effects on ductility in tension. It was found that the larger the compressive stresses the larger was the plastic deformation the material was able to withstand up to a point after which increased pressure action produced microcracks which then developed into transgranular and intergranular macrocracks and finally fracturing of the body. Qualitative analyses of lower and

upper inflections of maximum ductility curves established the lower inflection as a manisfestation of the physico-mechanical properties, whereas the flattening of the curve at higher strains was the result of geometrical non-uniformity of the deformation. It was shown that sufficiently large pressures are able to suppress the initiation of fracture cracks during deformation and that a joint action of extremely high pressures and deformation can heal defects in real polycrystalline copper samples. G.G.

N68-32766 National Lending Library for Science and Technology, Boston Spa (England).
THE DEVELOPMENT OF HIGH-STRENGTH MARAGING STEEL [SUR LE DEVELOPPMENT DU MARAGING A HAUTE RESISTANCE]
J. L. Castagne and Y. Cazin May 1968 11 p Transl. into ENGLISH from a Paper Presented at the 7th J. Des Aciers Specieux, St. Etienne, France, 16, 17 May 1968 In ENGLISH and FRENCH *Its* Transl. 68/210
Available from Natl. Lending Library, Boston Spa, Engl.

The various problems encountered in the development of high-strength maraging steel are briefly discussed. Results are presented on a quantitative evaluation which was conducted to determine the influence of various elements such as cobalt, molybdenum, nickel, and titanium, on the strength and ductility of the steel. B.S.D.

N68-32818# Aerospace Corp., El Segundo, Calif. Materials Sciences Lab.
CHEMICAL TINTING OF HAFNIUM AND ZIRCONIUM CARBIDES FOR METALLOGRAPHIC EXAMINATION
Robert L. Joyce, Kenneth R. Janowski, and James H. Richardson Nov. 1967 13 p refs
(Contract F04695-67-C-0158)
(TR-0158(3250-10)-11; SAMSO-TR-68-220; AD-671925)

An etchant is described that imparts color to the surface of hafnium and to zirconium carbide metallographic specimens. These colors not only provide a sharp delineation of individual grains, but also define the boundaries of eutectic colonies that contain both graphite and carbide. For a given specimen, similar orientations of grains may be inferred from similar coloration. Author (TAB)

N68-32866# Oak Ridge National Lab., Tenn. Metals and Ceramics Div.
A METALLOGRAPHIC STUDY OF THE ALLOTROPIC PHASE TRANSFORMATIONS IN CERIUM
C. C. Koch and C. J. McHargue *In its* 6th Rare Earth Res. Conf. [1967] p 416–427 refs (See N68-32824 20-06)

Some aspects of the phase transformations in cerium were studied by using metallography. The percent dhcp formed by athermal transformation vs temperature as determined by X-ray diffraction was confirmed by quantitative metallography. The influence of plastic deformation on the transformation was studied by deforming cerium specimens at temperatures above and below M_s. Metallography definitely indicated that deformation promotes the fcc → dhcp reaction. A M_d temperature was determined. It appears that a tensile component of deformation is necessary for the fcc → dhcp transformation, which may explain the conflicting evidence of the effect of deformation on this transformation. The influence of deformation on subsequent athermal transformation and reversion was studied. The morphology of the fcc ⇄ dhcp transformation was examined and lattice relationships inferred. Author (NSA)

N68-32867# Iowa State Univ. of Science and Technology, Ames. Inst. for Atomic Research.
THE YTTRIUM-LEAD ALLOY SYSTEM
O. N. Carlson, F. A. Schmidt, and D. E. Diesburg *In* Oak Ridge Natl. Lab. 6th Rare Earth Res. Conf. [1967] p 428–439 refs (See N68-32824 20-06)

The yttrium-lead alloy system was investigated by thermal analysis and microscopic and X-ray methods. An inverse peritectic reaction occurs on the yttrium-rich end of the system and there is a eutectic at 14 at. % Pb and 1240°C between yttrium and the compound, Y_5Pb_3, which melts congruently at 1760°C. The lead-rich side of the system consists of a series of peritectic reactions associated with three additional compounds. From X-ray diffraction data and microscopic evidence, the compositions of these compounds were determined to be Y_5Pb_4, YPb_2 and YPb_3. Horizontals corresponding to the decomposition temperatures of these compounds occur at 1650, 945, and 740°C, respectively. Author (NSA)

N68-32868# Iowa State Univ. of Science and Technology, Ames. Inst. for Atomic Research.
YTTERBIUM-LEAD AND EUROPIUM-LEAD SYSTEMS
O. D. McMasters *In* Oak Ridge Natl. Lab. 6th Rare Earth Res. Conf. [1967] p 440–448 refs (See N68-32824 20-06)

Differential thermal, metallographic, and X-ray parametric methods were used to establish the ytterbium and europium-lead phase diagrams. The terminal solid solubilities, eutectic points, liquidus curves, and horizontal reaction temperatures of these systems were determined. The intermetallic compounds Yb_2Pb, YbPb, $YbPb_3$, Eu_2Pb, EuPb, and $EuPb_3$ melt congruently. Both YbPb and EuPb compounds exhibit a polymorphis transformation. Compounds Yb_5Pb_3 and Eu_5Pb_3 form a peritectic reaction. Lattice parameter values and crystal structure data are given for most of these compounds. The valency characteristics of the rare earth component in these alloys are discussed. The crystal chemistry of these compounds is compared to that of the alkaline earth and trivalent rare earth compounds. Author (NSA)

N68-32870# Mound Lab., Miamisburg, Ohio.
THE CERIUM-IRON AND CERIUM-NICKEL BINARY SYSTEMS
J. M. Gebhart, III, D. E. Etter, and P. A. Tucker *In* Oak Ridge Natl. Lab. 6th Rare Earth Res. Conf. [1967] p 452–457 refs (See N68-32824 20-06)
(Contract AT(33-1)-GEN-53)

Phase equilibria in the cerium-iron and cerium-nickel binary systems were investigated by differential thermal analysis, thermal analysis, metallography and X-ray diffractions, and a phase diagram was developed for each binary system. The present work shows considerable disagreement with the earlier diagrams in the liquidus temperatures as well as the temperatures and compositions of the binary invariant points. Many of these discrepancies are probably the result of differences in purity of the cerium metal used in the studies. The current studies were conducted with cerium that melted at 804°C and had a reported purity of 99.9%. Author (NSA)

N68-32871# Denver Research Inst., Colo.
STUDIES OF THE SAMARIUM-GODOLINIUM SYSTEM
A. S. Yamamoto and C. E. Lundin *In* Oak Ridge Natl. Lab. 6th Rare Earth Res. Conf. [1967] p 458–468 refs (See N68-32824 20-06)
(Contract AT(11-1)-1298)

Phase relations in the Sm–Gd alloy system were established by collective analysis of various data. These data were obtained from microscopic examination, X-ray diffraction analysis, thermal analysis, density and microhardness measurements, as well as Knudsen-effusion experiments. Thermodynamic activities of samarium in the hexagonal close-packed phase in the temperature range from 1073 to 1373°K were calculated from the vapor-pressure data obtained in the Knudsen effusion studies. A plot of activities versus

mole fraction showed a negative deviation from ideality, or a tendency for unlike atom attraction. The phase equilibria exhibited complete miscibility both in liquid and solid. The characteristics of the two component metals are very similar, thus favoring the formation of such continuous solutions. Both metals are close-packed hexagonal, but differ in crystallographic stacking sequence from samarium-like to gadolinium-like, which is reflected in the alloy system by a gradual transition from the samarium structure of the gadolinium structure. Author (NSA)

N68-32945# General Electric Co., Pleasanton, Calif. Nucleonics Lab.
STAINLESS STEEL FAILURE INVESTIGATION PROGRAM Final Summary Report
R. N. Duncan Feb. 1968 80 p refs
(Contract AT(04-3)-189)
(GEAP-5530; EURAEC-2023) CFSTI: HC $3.00/MF $0.65

Experience with highly stressed austenitic stainless steel fuel rod cladding in water cooled power reactors indicated that type-304 stainless steel and other austenitic alloys were susceptible to stress assisted intergranular corrosion attack even though there were no carbide precipitates in the grain boundaries. Experimental work pertinent to this experience is reported. Corrosion testing of high-purity austenitic alloys with controlled impurity additions in HNO_3+ Cr^{6+} and in 650°F dilute iron chloride solutions indicated that C, Si, and P are of major importance in determining the intergranular corrosion resistance of austenitic alloys. C additions affect the intergranular corrosion resistance but are dependent on heat treatment before testing. Mn, S, Ni, and O had very little effect in either test media. Techniques used to explore differences between grains and grain boundaries in austenitic stainless steels include grain boundary microhardness measurements, and grain boundary polarization measurements. Author (NSA)

N68-32948# Bettis Atomic Power Lab., West Mifflin, Pa.
ABNORMAL PHENOMENA DURING STRESS RELAXATION IN BERYLLIUM BRONZE
S. V. Grachev and V. Ia. Zubov [1968] 6 p refs Transl. into ENGLISH from Izv. Vyssh. Ucheb. Zaved., Tsvet. Met. (Dzaudzhikau), v. 10, no. 2, 1967, p 121–123
(WAPD-TRANS-90) CFSTI: HC $3.00/MF $0.65

In producing elastic elements, such as springs, from beryllium bronze, an abnormal occurrence of the processes of direct and reverse anelastic creep is observed. Stress relaxation during bending of a thin strip of the alloy is frequently accompanied by a stress drop to zero, with subsequent redistribution and growth of stress with a reverse sign. Stress relaxation in the bronze at 300°C after quenching and tempering at various temperatures (to 500°C), was determined. Straight and reverse anelastic creep was plotted for the bronze at 200°C after quenching, at 300°C after quenching and aging at 100°C, 1 hr, and at 300°C after quenching and aging at 450°C, 1 hr. Straight anelastic creep of strip specimens was conducted in rings, reverse anelastic creep by heating the specimens in free state. Longest time of both straight and reverse anelastic creep was 10 hr. NSA

N68-32956# General Electric Co., San Jose, Calif. Nuclear Fuels Dept.
THE FABRICATION AND CHARACTERIZATION OF Zr-Cr ALLOY TUBING
H. J. Busboom, G. W. Cleveland, H. H. Klepfer, and H. L. Shannon Feb. 1968 43 p refs
(Contract AT(04-3)-189)
(GEAP-5589; EURAEC-2012) CFSTI: HC $3.00/MF $0.65

A Zr + 1.5 wt % Cr + 0.08 wt % Fe alloy (designated Zr-Cr) has been developed with the potential for improved service reliability as boiling water reactor fuel cladding. The fabrication of significant quantities of fuel cladding tubing and bar stock from a large ingot of Zr-Cr alloy is described. Characterization tests on these wrought products confirmed the excellent high purity water corrosion resistance for this composition at temperatures above 300°C. Mechanical properties were equal to present Zircaloy-2 fuel cladding tubing. Also described is an irradiation test program where the performance of Zr-Cr alloy clad fuel rods is being compared directly with similar Zircaloy-2 clad fuel rods in a boiling water power reactor environment. Included in this experiment are nonfueled dummy rods to separate the effects of heat transfer during irradiation on the corrosion of the Zr-Cr alloy. Author (NSA)

N68-32963 National Lending Library for Science and Technology, Boston Spa (England).
INFLUENCE OF STRUCTURAL CONDITION ON THE MAGNETIC PROPERTIES OF A COBALT-PLATINUM ALLOY
D. D. Mishin and V. S. Boldenko 10 Oct. 1967 4 p refs Transl. into ENGLISH Fiz. Metal. i Metalloved., v. 23, no. 3, Mar. 1967 p 570–572 In ENGLISH and RUSSIAN *Its* Transl. 67/270
Available from Natl. Lending Library, Boston Spa, Engl.

Results are presented on an investigation which was undertaken to study the relationship between variation in the relative volume of the ordered phase and the magnetic properties of the cobalt–platinum alloy specimen. It was assumed that a two-phase isotropic cobalt–platinum alloy constitutes a random collection of particles having a magnetically hard nucleus of an ordered phase and a magnetically soft shell of an unordered phase. A magnetic analysis was performed on the specimens which contained 48% cobalt and 52% platinum. Using a ballistic method, the following characteristics were measured: the magnetization curve, a portion of the demagnetization curve for the limiting hysteresis loop, and remanent magnetization intensity form the magnetization curve and the critical field equal to the maximum coercive force of the particle suitably oriented relative to the field. Relationships are given for calculating the ordered and disordered phases of the specimen. B.S.D.

N68-32975*# Battelle Memorial Inst., Columbus, Ohio.
OXIDATION BEHAVIOR OF CO-25CR AND CO-35CR ALLOYS Topical Report, 1 Nov. 1967–31 Mar. 1968
Per Kofstad and A. Z. Hed 4 Jun. 1968 40 p refs
(Grant NGR-36-002-070)
(NASA-CR-72420) CFSTI: HC $3.00/MF $0.65 CSCL 11F

The oxidation of Co-25Cr and Co-35Cr may be characterized as follows: At high oxygen partial pressure, the total cross-sectional area of the CoO channels in the scale formed on Co-25Cr alloys exceeds 0.1 percent of the total diffusional area. The rate-controlling process is diffusion of Co in these CoO channels. At low oxygen pressure during the oxidation of Co-25Cr, the total cross-sectional area of these channels decreases below the 0.1 percent level, and the channels are probably blocked completely. The rate-controlling process is the solid-state diffusion of Cr cations in a predominantly $CoCr_2O_4$ scale. The initial oxidation behavior may be explained on the basis of the transformation to spinel of the Cr_2O_3 layer produced preferentially during the preoxidation stages and perhaps also during the first stages of oxidation. Author

N68-32998# Bettis Atomic Power Lab., West Mifflin, Pa.
CONTRIBUTION TO THE STUDY OF THE OXIDATION OF ZIRCONIUM AND OF THE DIFFUSION OF OXYGEN INTO THE OXIDE AND INTO THE METAL
Jean Debuigne [1968] 68 p refs Transl. into ENGLISH from Metaux (St. Germain-en-Laye), v. 42, 1967 p 235–258
(WAPD-TRANS-0091) CFSTI: HC $3.00/MF $0.65

A precise study of the diffusion of O_2 into Zr necessitates a detailed knowledge of the physical and the physicochemical characteristics of solid solutions of O_2 in Zr and of the characteristics of oxide films formed on the metal. The X-ray diffraction study of homogeneous solid solutions indicates that the interstitial O_2 atoms are distributed in an ordered manner between the octahedral sites of the hexagonal lattice of a Zr. The adherence of the oxide

film to the surface of the metal and the mode of release of the mechanical stresses developed at the metal-oxide interface are conditioned partially by the mechanical characteristics of the metallic zone highly enriched in O_2 and adjacent to the oxide. The examination of the profile of the microhardness curves obtained in the metallic zone subjacent to the oxide shows that the decrease of the hardness as a function of the distance to the metal-oxide interface is not made in a regular manner but in steps. Author (NSA)

N68-33000 National Lending Library for Science and Technology, Boston Spa (England).
HOT-TORSION TEST, A SUITABLE TECHNIQUE FOR ASSESSMENT OF HOT-WORKABILITY
J. Langerweger and H. Trenkler 29 Jul. 1968 20 p Transl. into ENGLISH from Berg-Huttenmann. (Austria), no. 113, 1968 p 104–114 /*ts* Transl. No. 68/143
Available from Natl. Lending Library, Boston Spa, Engl.

The effects of structure and nonmetallic inclusions on the hot-working characteristics of various steels are investigated in an effort to derive a simple and reliable test method. A method for calculating the deformation resistance from torques obtained in torsion tests is discussed. Tests conducted with steels having carbon contents ranging from 0.08% to 0.78% indicate that the carbon content did not effect deformation in the γ field, but with a chromium steel with nickel additions it was also demonstrated that a change in the weight percent ratio of ferrite to austenite significantly affects the resistance to deformation. Tests were also made with unalloyed steels. Plastic properties, as expressed in terms of the number of twists to fracture, are strongly affected by material constitution. The steels were studied in the as-cast condition, after deformation, and following annealing. The effects of grain size and oxide inclusions were also investigated. K.W.

N68-33018*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
REVIEW OF BERYLLIUM TECHNOLOGY FOR SPACECRAFT APPLICATIONS
R. G. Moss 1 Nov. 1967 35 p refs
(Contract NAS7-100)
(NASA-CR-96319; JPL-TM-33-356) CFSTI: HC $3.00/MF $0.65
CSCL 11F

The present status and anticipated future developments in beryllium and beryllium alloys are described. Properties of beryllium together with its advantages and disadvantages are discussed. Current technology and project progress in fabrication, forming, joining, testing, and applications of beryllium are noted, as are a number of the more important programs in these areas. Author

N68-33019*# Du Pont de Nemours (E.I.) and Co., Aiken, S. C.
ROLE OF HYDROGEN CHLORIDE IN HOT SALT STRESS CORROSION CRACKING OF TITANIUM ALUMINUM ALLOYS
R. S. Ondrejcin and M. R. Louthan, Jr. Washington NASA Aug. 1968 29 p refs
(NASA Order R-124)
(NASA-CR-1133; DP(NASA)-1130) CFSTI: HC $3.00/MF $0.65
CSCL 11F

The reactions of titanium-aluminum alloys with andydrous HCl gas were studied, and the reaction products were found to be $TiCl_2$, $TiCl_3$, $TiCl_4$, Al_2Cl_6, and H_2. These products are considered to be intermediates in the hot salt stress corrosion cracking of titanium-aluminum alloys. These products are not normally identified because they oxidize and hydrolyze in the presence of oxygen, moisture, and heat. Fractographic examination of Ti-8Al-1Mo-1V specimens cracked by hot salt and HCl showed the same fracture mechanism in both cases--mechanical rupture accompanied by dislocation movement. It is proposed that stress-sorption is the mechanism of cracking, and that atomic hydrogen is the species sorbed. Author

N68-33031# General Electric Co., St. Petersburg, Fla. Neutron Devices Dept.
DUCTILITY AND FORMABILITY OF FOUR VARIETIES OF MOLYBDENUM SHEET
M. W. Mallett 17 May 1968 19 p
(Contract AT(29-2)-656)
(GEPP-35; R-68-ND-12) CFSTI: HC $3.00/MF $0.65

Powder metallurgy process Mo sheet from two manufacturers (Varieties A and B), a low alloy Mo sheet (Variety C) and an arc vacuum cast Mo sheet (Variety D) are evaluated for ductility and formability characteristics. Bend, Olsen cup, hardness, and tensile testing results, supplemented by weld bead tensile tests and metallographic studies, are given for all four varieties of Mo. Test results show that Variety C, a low alloy Mo, is about equal in formability to Variety A powder metallurgy sheet. Both Variety A and C sheets are superior in ductility and formability when compared with the other varieties of Mo tested. Author (NSA)

N68-33040# Atomics International, Canoga Park, Calif.
HELIUM EMBRITTLEMENT OF TYPE 316 STAINLESS STEEL
D. Kramer, K. R. Garr, C. G. Rhodes (North Am. Rockwell Sci. Center), and A. G. Pard 30 Apr. 1968 31 p refs
(Contract AT(04-3)-701)
(AI-AEC-12670) CFSTI: HC $3.00/MF $0.65

Helium was injected into small tensile samples of type 316 stainless steel by alpha particle irradiation from a cyclotron. Subsequent tensile testing at 540 to 815°C revealed a loss of ductility, as measured by elongation at failure. The lowest temperature at which a ductility loss was manifest depended upon the microstructure of the samples. A fine dispersion of sigma particles within the matrix was capable of raising this temperature by retarding the accumulation of He at grain boundaries. Reduced ductility was always accompanied by partial or complete intergranular failure and the presence of intergranular cracks. These cracks originated as small voids adjacent to grain boundary carbide particles, presumably through the action of grain boundary sliding. Large He bubbles found attached to carbide particles are responsible for the relative ease of void formation, as compared with samples without He. Author (NSA)

N68-33136# Brookhaven National Lab., Upton, N. Y.
EFFECT OF IRRADIATION ON MECHANICAL PROPERTIES OF COBALT BASE ALLOYS
J. G. Y. Chow [1968] 10 p refs Sponsored by AEC
(BNL-12438; Conf-680604-3) CFSTI: HC $3.00/MF $0.65

Commerical cobalt base alloys including Haynes 25 and UMCO 51 are potential fuel cladding materials at 650°C. These alloys are attractive over type 304 because of their higher strengths. The experimental alloys studied did not show advantages over the commercial alloys with respect to post-irridation elevated temperature ductility. Cobalt base alloys are susceptible to decreasing ductility with increasing deformation temperature after irradiation. The mode of failure at 800°C is grain boundary tearing similar to that observed in stainless steels and nickel base alloys. Author (NSA)

N68-33146# Aeronautical Research Labs., Melbourne (Australia).
THE EFFECT OF DEPTH OF MACHINING CUT ON THE FATIGUE PROPERTIES OF UNNOTCHED ALUMINUM ALLOY SPECIMENS
J. M. Finney, J. Y. Mann, and R. Simpson Dec. 1967 18 p refs
(ARL/SM-322) CFSTI: HC $3.00/MF $0.65

Residual stress measurements and rotating cantilever fatigue tests have been made on unnotched specimens of 2024-T4 and D.T.D. 683/3 extruded aluminum alloys machined from bar stock in either two or a series of four or five cuts. The cuts ranged from 0.346 inch to 0.004 inch in depth. It was found that the depth of cut caused no significant differences in the fatigue behaviour of either alloy. Author

N68-33159# Brookhaven National Lab., Upton, N. Y.
EFFECT OF MICROSTRUCTURE ON THE ELEVATED TEMPERATURE DUCTILITY OF IRRADIATED AUSTENITIC STAINLESS STEELS
J. G. Y. Chow [1967] 13 p refs Presented at Symp. on Radiation Effects in Reactor Metals, San Francisco Supported in part by AEC
(BNL-12439; Conf-680604-1) CFSTI: HC $3.00/MF $0.65

Deformation of 304 stainless steel to 18% at 77°K, annealing at 705°C, deforming again to 18% at 77°K, and annealing at 760°C for 16 hr developed a fine grained structure, with a fine precipitate of carbides, and elimination of the original austenitic grain boundaries. After irradiation to a fluence of 1.3×10^{20}, the elevated temperature strength was lower but ductility increased. Fracture was predominantly intergranular. NSA

N68-33212# Florida Univ., Gainesville. Metallurgical and Materials Engineering Dept.
THE INFLUENCE OF NEUTRON IRRADIATION, HEAT TREATMENT AND DEFORMATION ON THE MARTENSITIC TRANSFORMATIONS IN METASTABLE BETA SUB 1 BRASS Final Report
R. E. Hummel and J. W. Koger Apr. 1968 154 p refs
(Contract AT(40-1)-3395)
(ORO-3395-5) CFSTI: HC $3.00/MF $0.65

A study was made on the martensitic transformation in metastable β_1–Cu–Zn (with 38.3 to 39.4 wt % zinc) to determine the effect of repeated thermal cycling, deformation, annealing, bombardment with fast neutrons, and the presence of untransformable phases in these transformations. Transformations were monitored by measurement of electrical resistance complemented by optical and electron microscopy and x-ray diffraction analysis. The principal characteristics of the transformation on cooling, determined from resistance measurements, were found to be the M_s-temperature, the temperature coefficient of electrical resistivity of the phases, the area of the hysteresis loop of the transformation curve, and the rate of transformation. The M_s-temperature was found to change according to the treatment given the sample. Elastic deformation and the presence of retained martensite raised the M_s. The M_2-temperature was lowered after plastic deformation and neutron irradiation but was not affected by heat treatments up to 100°C. The neutron doses (φt) varied between 5×10^{18} and 5×10^{19} neutrons/cm^2 (E > 1 MeV). Neutron irradiation decreased the martensitic-start temperature (M_s) up to 8°C and increased the maximum rate of transformation.
Author (NSA)

N68-33236# Los Alamos Scientific Lab., N. Mex.
PERMEATION AND DIFFUSION OF NITROGEN, OXYGEN, AND RARE GASES THROUGH STAINLESS STEEL: A BIBLIOGRAPHY
Jean Furnish, comp. 9 May 1968 5 p refs
(Contract W-7405-ENG-36)
(LA-3909-MS) CFSTI: HC $3.00/MF $0.65

Twenty-four references are listed covering articles and reports published from 1947 to 1967. Phases itemized include permeability of tubes, behavior of nitrided steels, intergranular oxidation in 310 stainless steel, degassing, bimetallic systems, permeability of stainless and mild steel to Ar and He, and apparatus for studying diffusion of gaseous fission products in stainless steel.
Author (NSA)

N68-33242# Boeing Co., Renton, Wash. Commercial Airplane Div.
AN INVESTIGATION INTO THE RELATIONSHIP BETWEEN PRECRACKED CHARPY W/A AND PLANE STRAIN FRACTURE TOUGHNESS FOR HIGH STRENGTH STEELS
C. S. Carter 22 May 1968 22 p refs
(D6-23352-TN; AD-671439)

The relationship between K sub IC, established by fracture mechanics procedures, and W/A, determined from precracked Charpy tests, has been examined. Both plain and side grooved Charpy specimens were used. Correlations have been established but these show some scatter. This prevents an accurate prediction of K sub IC from W/A values but a rough estimate can be obtained.
Author (TAB)

N68-33257# Aerojet-General Corp., Sacramento, Calif. Materials Research Lab.
TERNARY PHASE EQUILIBRIA IN TRANSITION METAL-BORON-CARBON-SILICON SYSTEMS. PART 1: BINARY SYSTEMS. VOLUME 13: THE ZIRCONIUM-SILICON AND HAFNIUM-SILICON SYSTEMS
C. E. Brukl Wright-Patterson AFB, Ohio AF Mater. Lab. May 1968 72 p refs
(Contract AF 33(615)-1249)
(AFML-TR-65-2, Pt. 1, V. 13; AD-671550)

The zirconium-silicon and hafnium-silicon binary systems were investigated by means of Debye-Scherrer X-ray analysis, metallography, melting points, differential analysis techniques, and chemical analysis. Both silicide systems contain a D8(8)-type phase which is stabilized by trace impurities of oxygen and nitrogen. The binary phases present are: Zr4Si, Zr2Si, Zr3Si2, Zr5Si4, alpha- and Beta-ZrSi, and ZrSi2; in the hafnium system: Hf2Si, Hf3Si2, Hf5Si4, and HfSi2. The ZrSi phase undergoes an allotropic transformation at 1550C; the high temperature form is of the CrB type while the low temperature crystal structure is of the FeB type. Complete phase diagrams from 1100C up to melting are given.
Author (TAB)

N68-33273# Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.
IMPROVED TENSILE PROPERTIES OF HASTELLOY X-280 AND INCONEL 600 AFTER HIGH TEMPERATURE IRRADIATION
I. S. Levy 13 May 1968 33 p refs Presented at the ASTM Symp. on Effects of Radiation on Structural Metals, San Francisco, 26–28 June 1968
(Contract AT(45-1)-1830)
(BNWL-SA-1442; Conf-680604-6) CFSTI: HC $3.00/MF $0.65

Tension specimens of Hastelloy X-280 and Inconel 600 that were given various experimental preirradiation treatments were irradiated at 1250°F to a fast fluence of approximately 1×10^{20} n/cm^2 (E>1MeV) in a thermal reactor. Then they (and their controls) were subjected to tension tests and electron microscopy. The experimental treatments produced significant improvements in both thermal stability and radiation stability, with the result that increases occurred in postirradiation uniform elongation, relative to standard treatments, of from 300% in Hastelloy X-280 to 550% in Inconel 600. These property improvements are rationalized in terms of interactions of the microstructure produced by the treatments with the thermal and radiation environments.
Author (NSA)

N68-33274# Naval Ship Research and Development Center, Annapolis, Md.

CORRELATIONS BETWEEN FLEXURAL AND DIRECT STRESS LOW-CYCLE FATIGUE TESTS

M. R. Gross and E. J. Czyryca Aug. 1967 23 p
(Rept.-2460; AD-656746)

Flexural and direct stress low-cycle fatigue results for six materials are compared. The materials are HY-100 and HY-140 steels, Monel-400, cast and wrought 70-30 cupronickel, and Ni-Al bronze. It is concluded that the two test methods give equivalent results within the life range investigated when correlated on a total strain range basis. Correlations based on nominal stress are not as good because of differences between the cyclic stress-strain relationships for the two types of tests. Author (TAB)

N68-33278*# National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.

INFLUENCE OF CHEMISORBED FILMS ON ADHESION AND FRICTION OF CLEAN IRON

Donald H. Buckely Washington Sep. 1968 14 p refs
(NASA-TN-D-4775) CFSTI: HC$3.00/MF$0.65 CSCL 11F

Studies were conducted in a vacuum of 10^{-10} torr with clean polycrystalline iron and with iron containing various films. Results indicate strong adhesive forces for the clean iron; because of the magnitude of these forces friction could not be measured. These forces were appreciably reduced in the presence of adsorbates. Carbon dioxide dissociated on the surface, resulting in metal oxide and carbon monoxide. Water vapor was more effective in reducing friction than was oxygen of the same exposure. With hydrocarbons, the number of carbon-to -carbon bonds influenced friction and adhesion. Friction decreases with chain length and with the number of carbon-to -carbon bonds for a particular chain length. Author

N68-33335*# Materials Research Corp., Orangeburg, N. Y.

AN ALUMINUM NITRIDE MELTING TECHNIQUE

Walter Class Washington NASA Sep. 1968 49 p refs
(Contract NAS3-10659)
(NASA-CR-1171) CFSTI: HC$3.00/MF0.65 CSCL 13H

Experimental studies were undertaken to evaluate the melting behavior of aluminum nitride and, particularly, to determine if pressures of ≤200 atm were sufficient to suppress the decomposition of AlN at its melting point. To determine this as well as the actual melting point of AlN, crucible melting was accomplished in resistively heated crucibles and arc melting was carried out on a cooled copper hearth to achieve uncontaminated AlN melts. The former method permitted the achievement of pressure stabilized melts; although the graphite, rhenium, and tungsten crucible materials reacted with the AlN to prevent an accurate determination of its melting point. The AlN does, however, appear to melt between 2750 and 2850°C. A nitrogen atmosphere at a pressure of 1500 psi was sufficient to suppress decomposition, although this conclusion can be questioned because of the presence of chemical reaction. M.W.R.

N68-33339 National Lending Library for Science and Technology, Boston Spa (England).

STUDY OF A Mo-W STAINLESS STEEL WITH OUTSTANDING CREEP PROPERTIES [ETUDE D'UN ACIER INOXYDABLE AU Mo-W A HAUTES CARACTERISTIQUES DE FLUAGE]

J. DeCroix 2 Feb. 1968 7 p Transl. into ENGLISH of Centre de Rech. Ugine Kuhlmann Lab. Rept. 42469, 30 Jun 1967 In ENGLISH and FRENCH *Its* Transl. 67/367
Available from Natl. Lending Library, Boston Spa, Engl.

The development of an austenitic steel, designated Z 10 CNKDW 18, which can be used without precipitation hardening treatment, and which exhibits high speed tensile and creep properties intermediate between those of solution treated steels and those of precipitation hardenable steels; is reported. The composition adopted in principle was that of a classic Cr-Ni austenitic steel, containing an addition of tungsten as a basis for creep strength and, an addition of nitrogen for improving the elastic limit under rapid tensile stress. Other additives for increasing creep strength and elastic limits included molybdenum, manganese, vanadium, carbon, boron, and niobium. Characteristics of the steel studied in the hot finished condition, either after solution treatment or after controlled warm working are described. Also assessed are the characteristics of cold finished products, the effects of Nb additives in improving elastic limits at high and low working temperatures; and weldability. It is concluded that (1) the combined properties of A 5 CNWD 18 steel give it a creep strength greater than that of the classic austenitic steels; (2) the limit of elasticity and elongation resistance through creep can be adjusted within a wide range, thus making this steel competitive with precipitation-hardenable creep-resistant steels; (3) because of its hot ductility, the steel can be welded using filler material of the same composition without risk of cracking in the joint or heat affected zone; and (4) additions of niobium are beneficial in the case of hot finished products subjected to controlled working. S.C.W.

N68-33340 National Lending Library for Science and Technology, Boston Spa (England).

POROUS COMPACTS IN SINTERED CHROMIUM–NICKEL STEEL [POROESE FORMKOERPER AUS GESINTERTEM CHROM-NICKEL-STAHL]

Ludwig Elsner 29 Jul. 1968 15 p refs Transl. into ENGLISH from Deut. Edelstaalwerke Tech. Ber. (Krefeld), v. 7, 1967 p 120–125 In ENGLISH and GERMAN *Its* Transl. 68/116
Available from Natl. Lending Library, Boston Spa, Engl.

Manufacturing techniques; characteristic properties (i.e., external complete porosity, permeability, and effective pore size); and applications of porous chromium-nickel steel compacts in conveyor-bed technology, filter technology, and flash-back safety devices; are discussed. S.C.W.

N68-33346 National Lending Library for Science and Technology, Boston Spa (England).

SOME PROBLEMS OF ALLOYING OF CAST ALLOYS

Y. A. Nekhendzi and S. S. Shpindler 10 Oct. 1967 6 p refs Transl. into ENGLISH from the Publ. "Svoistva i Primen. Zharoproch. Slavov, Inst. Met. A.A. Baikova" Ussr, Akad. Nauk Sssr, 1966 p 222–228 In RUSSIAN and ENGLISH *Its* Transl. 67/231
Available from Natl. Lending Library, Boston Spa, Engl.

Stress rupture and creep resistance properties of precision-cast steel specimen predominantly strengthened with (1) carbides and carbonitrides, and (2) the ferrite forming elements Mo, W, Nb, and Ti, were determined under conditions simulating the solidification of thin walled castings for gas turbine blades. Objectives of these studies were to determine the effects of alloy strengthening elements on phase composition and heat resistance properties at high temperatures. Studied were the properties of steels with the basic compositions 15/5, 20/10, 20/20, and 15/35. Stress rupture tests were performed at temperatures of 650 and 700°C. Creep tests were performed at 650° C and a stress of 13 kg/mm^2. Specimen were subjected to the following heat treatment: quenching for one hour at 1250°C, and air plus ageing for four hours at 750°C. Comparative studies of steels with prescribed basic compositions indicated that to secure a high rupture strength in steels with a lower nickel base, a lower total maximum possible amount of carbide and ferrite forming elements is required. Established patterns denoting the influence of alloying elements on phase composition and heat resistance made possible the selection of components and limiting concentrations for attaining predetermined, high heat resistance properties at temperatures up

to 750°C in complex Fe–Cr–Ni steels. Two new cast heat resisting steels (PZh-1 and PZh-2) capable of operation at temperatures of 600 to 750°C, which have applications in the construction of gas turbine blades, are described. S.C.W.

N68-33348 National Lending Library for Science and Technology, Boston Spa (England).

CARBIDE ANALYSIS OF A CAST CHROMIUM–NICKEL ALLOY

L. N. Zimina, E. F. Yakovleva, and D. N. Zharkova 10 Oct. 1967 6 p refs Transl. into ENGLISH from Sb. Tr. Tsentr. Nauchn.-Issled. Inst. Chernoi Met. (Moscow), no. 32, pt. 2, 1963 p 103–110 In ENGLISH and RUSSIAN *Its* Transl. 67/249

Available from Natl. Lending Library, Boston Spa, Engl.

To elucidate the role played by the carbide phase in heat resisting alloys, a study was made of a cast nickel-base alloy containing chromium, cobalt, molybdenum, and tungsten strengthened by dispersed $(Ni, Co)_3(Al, Ti)$ phase precipitates. Carbide phases isolated electrolytically from the alloy after various heat treatments (quenching with subsequent ageing at a temperature of 1050°C) were subjected to X-ray structural analysis. Results of X-ray analysis demonstrated that two types of carbide, TiC and Me_6C, Fe_3W_3C) were present in the structure of the alloy after water quenching from 1250°C and air quenching form 1275°C. In addition, a Y boride phase was observed. During ageing or slow cooling from high temperatures, the $Me_{23}C_6$ (Fe_3W_3C) carbide was precipitated in the alloy. To determine the composition of each carbide constituent, phase separation was performed. A deposit consisting of the four phases TiC, $Me_{23}C_6$, Me_6C, and Y was treated with a mixture of hydrochloric acid and ethyl alcohol with gentle heating. Titanium carbide and cubic chromium carbide were individually separated from the four phases; however, attempts to seperate the Me_6C carbide and the boride Y phase were unsuccessful. S.C.W.

N68-33354# Battelle Memorial Inst., Richland, Wash. Pacific Northwest Lab.

POSTIRRADIATION TENSILE BEHAVIOR OF 300 SERIES STAINLSSS STEELS

J. J. Holmes, R. E. Robbins, and A. J. Lovell 28 Jun. 1968 27 p refs Presented at the ASTM Symp. on Effects of Radiation on Structural Metals, San Francisco, 26–28 Jun. 1968

(Contract AT(45-1)-1830)

(BNWL-SA-1455; Conf-680604-7) CFSTI: HC$3.00/MF$0.65

The effects of neutron irradiation on the tensile properties of several austenitic stainless steels are considered over a wide fluence and temperature range. At low fluence levels (about 10^{20} n/cm^2), displacement damage results in radiation hardening if the irradiation and test temperatures are below one-half the absolute melting temperature (0.5 Tm) of the steel. Above 0.5 Tm, hardening no longer exists but a ductility loss due to helium embrittlement is observed. The temperature above which irradiation hardening is no longer significant increases with increasing fluence. The hardening observed at temperatures below 0.5 Tm is attributed to classical displacement damage. Elevated temperature hardening the fast reactor irradiations is the result of void formation. The hardening observed after thermal reactor irradiations appears to be due to the formation of gas filled bubbles, but the nature of the gas is not clear. Author (NSA)

N68-33356 National Lending Library for Science and Technology, Boston Spa (England).

METALLOGRAPHIC STUDIES OF THE EFFECT OF MOLYBDENUM ON THE PRECIPITATION BEHAVIOR OF HEAT-RESISTANT NICKEL–CHROMIUM AND NICKEL–CHROMIUM–COBALT ALLOYS [METALLKUNDLICHE UNTERSUCHUNGEN UEBER DEN EINFLUSS VON MOLYBDAEN AUF DAS AUSSCHEIDUNGSVERHALTEN HOCHWARMFESTER NICKEL–CHROM UND NICKEL–CHROM–KOBALT-LEGIERUNGEN]

W. Peter, H. Mueller, and E. Kohlhaas 10 Oct. 1967 8 p Transl. into ENGLISH from Arch. Eisenhuettenw. (Duesseldorf), v. 38, 1967 p 329–335. In ENGLISH and GERMAN *Its* Transl. 67/253

Available from Natl. Lending Library, Boston Spa, Engl.

The effect of 4.5% molybdenum additives on carbide and gamma phase $Ni_3(TiAl)$ precipitation processes occurring in X 8 NiCrAlTi 75 20 and NiCoCrTi 55 20 alloys during long time exposure at 750°C with and without stress; and the influence of various heat treatments during short-time tests at 800°C are assessed in an metallographically attempt to demonstrate the beneficial effects of molybdenum and suitable heat treatment on creep properties (creep strength, elongation at rupture, and time to rupture). S.C.W.

N68-33357 National Lending Library for Science and Technology, Boston Spa (England).

INFLUENCE OF LEAD AND BORON ON THE STRUCTURE AND PORPERTIES OF A HEAT-RESISTING ALLOY

G. S. Chernyak and A. P. Gulyaev 10 Oct. 1967 5 p refs Transl. into ENGLISH from Metalloved. i Term. Obrabotka Metal. (Moscow), no. 1, Jan. 1967 p 12–15 In ENGLISH and RUSSIAN *Its* Transl. 67/266

Available from Natl. Lending Library, Boston Spa, Engl.

A study designed to determine the effects of lead and boron impurities on the micro-structure and mechanical properties of EI617 alloy (15Cr 3Mo 6W V Al Ti Ni base) is reported. To determine changes in the structure of the eutectic, as-cast specimen machined from the same zone were heated in a vacuum furnace and observations were made during heating to 350, 500, 800, and 1000°C. Mechanical properties in short-time rupture at 20 and 800°C, as wall as the time-to-rupture at 850°C, and a stress of 25 kg/mm^2 were determined after the following heat treatment: 2-hr heating at 1190°C, 4-hr heating at 1050°C, and 16-hr ageing at 800°C. Results indicated that: (1) With rising lead content of EI617 alloy, time-to-rupture, percentage elongation, and reduction in area in long-time tests at 850°C and δ –25 kg/mm^2 decrease; however, lead additions do not affect mechanical properties in short-time tests at 20 and 800°C. (2) Additions of up to 0.10% boron to the alloy containing up to 0.020% Pb improves heat resistance properties and other properties adversely affected by the addition of lead. (3) The deterioration in heat resistance properties is due to the fact that the amount of the lead eutectic in the alloy increases with rising lead content of the latter; hence, the neutralizing action of boron consists essentially in diminishing the amount of the lead eutectic. S.C.W.

N68-33358 National Lending Library for Science and Technology, Boston Spa (England).

THE INFLUENCE OF CARBON CONTENT ON FATIGUE STRENGTH OF COMMERCIAL GRADES OF PURE IRON [EINFLUSS DES KOHLENSTOFFGEHALTES AUF DIE WECHSELFESTIGKEIT TECHNISCHER REINEISENSORTEN]

Max Hempel and Emil Hillnhagen 29 Jul. 1968 29 p refs Transl. into ENGLISH from Arch. Eisenhuettenw. (Duesseldorf), v. 39, 1968 p 283–298 In ENGLISH and GERMAN *Its* Transl. 68/183

Available from Natl. Lending Library, Boston Spa, Engl.

Reported are results of (1) tests performed on air and vacuum molten grades of iron having carbon contents of approximately 0.003 to 0.15% which were conducted to determine the effects of carbon content, grain size, and yield point ratio on fatigue strength; and (2) results of metallographic observations on fatigue stress materials which were conducted to obtain data relating to the stress at which the first deformation traces occur, and to obtain an understanding of the influence of stress conditions on the initiation and formation of slip traces and incipient fatigue fractures. S.C.W.

N68-33359 National Lending Library for Science and Technology, Boston Spa (England).

THE INFLUENCE OF LOW-TITANIUM ADDITIONS ON THE PROPERTIES OF CRYSTAL-ORIENTED ALNICO ALLOYS [EINFLUSS GERINGER TITANZU SAETZE AUF DIE EIGENSCHAFTEN KRISTALLORIENTIERTER ALNICO-LEGIERUNGEN]

R. Wittig, E. Lindner, and K. Paessler 10 Oct. 1967 2 p refs Transl. into ENGLISH from Neue Huette (Leipzig), v. 12, 1967 p 367–369 In ENGLISH and GERMAN *Its* Transl. 67/283

Available from Natl. Lending Library, Boston Spa, Engl.

The effects of up to 1.5% titanium additions on crystal growth and magnetic properties of Alnico alloys (permanent magnet materials) was studied (1) to determine the feasibility of improving coercive field strength of Alnico magnets without crystal orientations, and (2) to test the validity of previously reported data which indicate that titanium additions prevent columnar crystallization at levels in excess of 0.5%. Of primary interest was the development of an alloy having the composition: 24% cobalt, 14% nickel, 8% aluminum, 3% copper, and balance iron. Crystallization and magnetic properties of alloys with additions of 0.5, 1.0, and 1.5% titanium were studied. The magnets of all test alloys exhibited a marked columnar crystallization with well oriented crystallites, the columnar crystals becoming progressively finer as titanium content was increased. In studies of magnetic properties, values for remanence and coercive field strength in specimen containing 0.5% titanium were virtually the same as those for magnets titanium-free. The alloy containing 1% titanium showed a slight increase in remanence but had an appreciably improved coercive field strength. Magnets with 1.5% titanium showed less favorable magnetic properties in spite of well defined columnar crystal formation. Results indicate that it is feasible to produce cast magnets of Alnico alloys possessing well defined columnar crystals with a 24% cobalt base containing a titanium content of at least 1.5%. S.C.W.

N68-33386*# Lockheed Nuclear Products, Marietta, Ga.

LOW TEMPERATURE ANNEALING OF IRRADIATED COMMERCIALLY PURE TITANIUM

C. A. Schwanbeck May 1968 52 p refs

(Contract NAS3-10298)

(NASA-CR-72428; LAC-ER-9887) CFSTI: HC $3.00/MF $0.65 CSCL 11F

Results obtained in an experimental study of the effects of post-irradiation annealing at cryogenic temperatures on the tensile properties of commercially pure titanium (Titanium 55A-Annealed) are described. Test specimens were exposed to fluences of 6×10^{17} n/cm^2, with neutron energies greater than 0.5 MeV (80 femtojoules), at 17°K. The irradiated specimens were tested after annealing periods of one hour (3.6×10^3 sec) at 78°K and 178°K. Parallel sample lots were tested at the annealing temperature and after recooling to 17°K. Additional specimens were tested at 17°K following irradiation at 17°K with no post-irradiation annealing period. The sample lots tested at 17°K following post-irradiation annealing showed that a pronounced reduction of the ultimate tensile strength occured at temperatures below 78°K, while a less pronounced effect on the tensile yield strength occurred over the entire annealing temperature range. The sample lots tested at the post-irradiation annealing temperature showed a gradual reduction in the irradiation effect on the ultimate tensile strength over the range of test temperatures. This reduction was substantial while there was relatively little reduction in the yield strength. Author

N68-33443# Oak Ridge National Lab., Tenn.

EFFECT OF NEUTRON IRRADIATION ON THE PLASTIC DEFORMATION OF IRON SINGLE CRYSTALS OF DIFFERENT CARBON CONTENT. 2: PLASTIC STRESS-STRAIN CURVES

Gerd-Peter Seidel [1968] 16 p refs Transl. into ENGLISH from Z. Metallk. (Stuttgart), no. 59, 1968 p 82-88

(ORNL-TR-1930) CFSTI: HC $3.00/MF $0.65

The influence of neutron irradiation on the stress-strain curves of iron single crystals of two different carbon contents (20 and ≤8 ppM by weight) was investigated. The measurements were carried out in dependence of the neutron dose, the deformation temperature and after different annealing treatments. In comparison the stress-strain curves of unirradiated samples were measured. The stress-strain curves of crystals with orientations in the interior of the unit triangle show at higher temperatures (≥273°K) three-stage-hardening similar to those of face-centered cubic metals; at lower temperatures they are monotonically curved. The shape of the stress-strain curve of unirradiated crystals depends on the carbon content. The influence of neutron irradiation on the stress-strain curves is more pronounced for crystals with higher carbon content, than for those with less carbon content. Author (NSA)

N68-33444# Oak Ridge National Lab., Tenn.

THE EFFECT OF NEUTRON IRRADIATION ON THE PLASTIC DEFORMATION OF IRON SINGLE CRYSTALS OF DIFFERENT CARBON CONTENT. 3: CHARACTERISTIC QUANTITIES OF STRAIN HARDENING

Gerd-Peter Seidel [1968] 12 p refs Transl. into ENGLISH from Z. Metallk. (Stuttgart), no. 59, 1968 p 88–93

(ORNL-TR-1931) CFSTI: HC $3.00/MF $0.65

The dependence of the stress-strain curves of neutron irradiated iron single crystals on the carbon content, the neutron dose and the deformation temperature, are studied in detail with the help of the work hardening parameters. The slopes and extensions of the linear work-hardening stages depend strongly on the neutron dose and imputity content (carbon). In addition, the slope depends strongly on the crystal-orientation. Qualitatively these results correspond to the behavior of face-centered cubic metals. In contrast to these it was found, however, that the slope increases with deformation temperature. Author (NSA)

N68-33473# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

ELASTIC PROPERTIES OF A NIOBIUM VANADIUM CHROMIUM SYSTEM OF ALLOYS [PRUZNI VLASTYVOSTI SPLAVIV SYSTEMY NYUBIY VANADIY KHROM]

I. M. Nedyukha and V. G. Chorniy 13 Sep. 1967 8 p refs Transl. into ENGLISH from Dopovidi Akad. Nauk Uk. RSR (Kiev), no. 3, 1966 p 352–354

(FTD-HT-67-130; AD-671651)

The effect of vanadium on the elastic properties of niobium or niobium-4% chromium alloy has been investigated. Alloys containing 5, 10, 15, or 20% vanadium were melted from 99.4%-pure niobium, 99.5%-pure vanadium, and 99.92%-pure chromium in an arc furnace in an inert atmosphere. Author (TAB)

N68-33567 National Lending Library for Science and Technology, Boston Spa (England).

POSSIBILITIES OF IMPROVING HOT-DUCTILITY OF ALLOY STEELS

G. Kuhnelt 29 Jul. 1968 24 p Transl. into ENGLISH from Berg-Huttenmannische Mh. (Austria), no. 113, 1968 p 114–124 *Its* Transl. No. 68/174

Available from Natl. Lending Library, Boston Spa, Engl.

Evaluated are the effects of casting technique, ferrite content, and aluminum nitride precipitation on the hot ductility of alloy steels. Torsion twist to fracture tests on various steel samples show a correlation between structural formation and crack initiation during rolling and forging; austenitic low alloy steels and austenitic chromium-nickel steels with ferrite possess high fracture tendencies

according to structural grain distributions and percentage of ferrite present. Low alloy nickel steels with aluminum content also show little plasticity during forming; long duration heating at 1000°C improves their ductility by coagulation of aluminum nitride into larger particles. G.G.

N68-33572 National Lending Library for Science and Technology, Boston Spa (England).
NATURE OF THE CHANGE IN THE HIGH-TEMPERATURE DUCTILITY OF PRECIPITATION-HARDENING ALLOYS
E. E. Lavin and B. M. Gugelev 10 Oct. 1967 5 p refs Transl. into ENGLISH from Metalloved. i Term. Obrabotka Metal. (Moscow), no.1, Jan. 1967 p 2–5 In RUSSIAN and ENGLISH *Its* Transl. 67/265
Available from Natl. Lending Library, Boston Spa, Engl.

The change of intergranular slippage as a function of temperature does not occur in a uniform manner. Intergranular slippage increases with rise in temperature only until the beginning of coagulation and dissolution of the dispersed phase. Within the temperature range of coagulation and dissolution of the strengthening phase, intergranular slippage decreases. After the dissolution of the dipersed phase, a further increase in temperature brings about an intensification of intergranular deformation. The initiation and degree of propagation of intergranular cracks during deformation are governed by the magnitude of mutual grain slippage. The maximum extents of slippage and damage build-up coincide. Boundary migration during high temperature deformation promotes an improvement in the ductility of the alloy. The high temperature deformation of the alloys exhibits two ductility minima, each of which is associated with a maximum in the development of intergranular slippage. Author

N68-33596 National Lending Library for Science and Technology, Boston Spa (England).
DESCRIPTION OF THE CREEP OF METALS, WITH ALLOWANCE FOR THE ELASTIC AFTEREFFECT [OB OPISANII POLZUCHESTI METALLOV S UCHETOM UPRUGOGO POSLEDEISTVIYA]
E. A. Khein May 1968 8 p refs Transl. into ENGLISH from Mekhan. Tverd. Tela, no. 2, 1966 p 103–105
(RTS-4546) Available from Natl. Lending Library, Boston Spa, Engl.: 7s 6d

Proposed is a rheological model of creep which consists of a Maxwell section with a nonlinearity viscous element (the irreversible component of creep deformation) and a combination of Kelvin-Voight sections, modeling the linear after effect. The model describes the recovery, i.e., the reversible creep. Comparative studies were made of calculated and experimental relaxation curves for steel EI 723 at a temperature of 580°C which were made using (1) the proposed model, (2) the ageing theory, (3) the hardening theory, and (4) the nonlinear heredity theory in the Rabotnov form. Results indicated that best agreement was achieved with the theory of irreversible creep allowing for the after-effect, and worst agreement was achieved with the flow theory. Results further confirmed the influence of recovery on the stress relaxation process and the feasibility of describing the creep of metals under steady conditions using the theory of irreversible creep with elastic lag. S.C.W.

N68-33600 National Lending Library for Science and Technology, Boston Spa (England).
THE STRENGTH AND DUCTILITY OF METALS AND ALLOYS [PROCHNOST' I PLASTICHNOST' METALLOV I SPLAVOV]
Yu. V. Mil'man Jun. 1968 29 p refs Transl. into ENGLISH from Vopr. Fiz. Metal. i Metalloved., Akad. Nauk Ukr. SSR, Sb. Nauchn. Rabot (Kiev), 1964 p 3–24
(RTS-4599) Available from Natl. Lending Library, Boston Spa, Engl.: 40s

Comparative results of experiments on Cr-Fe and W-Re alloy systems are presented which (1) demonstrate the mechanism by which alloying elements affect the transition temperature of alloys, and (2) clarify the role of twinning in lowering transition temperature S.C.W.

N68-33602 National Lending Library for Science and Technology, Boston Spa (England).
INVESTIGATIONS INTO THE INFLUENCE OF SURFACE TREATMENT ON FATIGUE PROPERTIES OF STEEL [EINIGE UNTERSUCHUNGEN UEBER DEN EINFLUSS DER OBERFLAECHENBEHANDLUNG AUF DIE ERMUEDUNG-SEIGENSCHAFTEN DER STAEHLE]
A. Buch and J. Chodorowski 10 Oct. 1967 3 p Transl. into ENGLISH from Haerterei-Techn. Mitt., v. 22, no. 2, 1967 p 157–159 In ENGLISH and GERMAN *Its* Transl. 67/257
Available from Natl. Lending Library, Boston Spa, Engl.

Reported are studies on the influence of: (1) heat and surface treatment on the dependence of surface hardness of alloys and steels on the number of cycles; (2) salt-bath nitriding on fatigue strength of 40H (41Cr4) steel; and (3) decarburization and shot-peening on fatigue strength. In studies of the dependence of hardness on number of cycles fatigue tests were made using specimens stressed at one end and using a rotating beam tester. Hardness changes were determined by the Vickers technique with a 2.5 kg load. Results of studies of heat treated and annealed carbon steels, heat treated and annealed cold rolled 0.45% carbon steels, and case-hardened 12 HN 3A steel are presented. Studies of the influence of salt-bath nitriding on fatigue strength properties of 40H (41Cr4) steel in various states of heat treatment indicated that: (1) the maximum increase in alternating fatigue strength occurred in specimen salt-bath nitrided in the tempered state; and (2) the alternating fatigue strength of specimen salt-bath nitrided in the normalized state lies close to the fatigue strength of specimen heated to σ_B = 90 kg/mm^2. The influence of depth of decarburization and shot-peening on fatigue strength was studied using specimen and springs of chromium-vanadium steel. The fatigue strength of the decarburized specimen was 40% lower than that of non-decarburized specimen, while the fatigue strength of decarburized specimens was 15% higher after shot-peening than that of specimen not shot-peened and not decarburized. S.C.W.

18 MATERIALS, NONMETALLIC

Includes corrosion; physical and mechanical properties of materials (e.g., plastics); and elastomers, hydraulic fluids, etc. For basic research see: 06 Chemistry. For related information see also: 17 Materials, Metallic; 27 Propellents; and 32 Structural Mechanics.

N68-32257 Princeton Univ., N. J.
MULTIVARIABLE STUDIES OF NONWOVEN FABRICS
Samuel Clyde Winchester (Ph.D. Thesis) 1967 135 p
Available from Univ. Microfilms: HC $6.40/MF $3.00 Order No. 67-13515

The performance characteristics of nonwoven fabrics have been studied as a function of fiber properties, binder properties and web construction properties. The responses studied were those related to rupture, elastic and handle (aesthetic) properties. Fourteen variables were investigated: base fiber linear density, base fiber

staple length, amount of crimp in base fiber, post-yield extension of base fiber, type of binder, linear density of binder, staple length of binder, binder concentration, mass per unit area of nonwoven, amount of needle-looming, number of laminations per web weight, pressure of bonding, temperature of bonding and time of bonding. The performance characteristics measured as a function of these variables were maximum tenacity at dry and wet conditions, elongation at dry and wet conditions, tear strength, abrasion resistance, elastic modulus at dry and wet conditions, proportional limit at dry and wet conditions, crease recovery, bending length, flexural rigidity, bending modulus, bulk density and air permeability. Dissert. Abstr.

N68-32268 Rutgers Univ., University Park, N. J.
AN INVESTIGATION OF THE EFFECTS OF ZINC OXIDE ON THE STRUCTURE OF GLASSES IN THE SYSTEM SODIUM OXIDE ZINC OXIDE SILICON DIOXIDE
John Calvin Hurt (Ph.D. Thesis) 1967 235 p
Available from Univ. Microfilms: HC $10.60/MF $3.05 Order No. 67-14720

The effects of zinc oxide on the structure of glasses of the general chemical composition, Na_2O-ZnO-SiO_2 were investigated using thermal expansion, refractive index, molar refraction, density, molar volume, and internal friction data. None of the properties measured showed a discontinuity or abrupt change in slope with compositional changes. The decrease in thermal expansion observed when zinc oxide replaced sodium oxide in the compositions was shown to result from the decrease in the average cation coordination of the non-bridging oxygens and an increase in the freedom of the non-bridging oxygens to vibrate in the transverse mode. The data was best explained when the theory of polarizability and interpenetration of electron orbitals in the zinc-oxygen bond was used. If the proposed hypothesis of the open structure were true, the activation energy for sodium ion diffusion would decrease with an increase in zinc oxide content which did not agree with observed data. Dissert. Abstr.

N68-32272# Royal Aircraft Establishment, Farnborough (England).
THE EFFECT OF PRE-STRESSING ON THE STRENGTH OF UNI-DIRECTIONAL LAMINATES [INFLUENCE DE LA PRECONTRAINTE SUR LA RESISTANCE DES STRATIFIES UNIDIRECTIONNELS]
M. Hediard Apr. 1968 38 p refs Transl. into ENGLISH of the ONERA Note, v. 104, 1967
(RAE-LIB-TRANS-1292) CFSTI: HC $3.00/MF $0.65

The strength of standard laminates is relatively low when compared to the strength of the glass fibers reinforcing them. One of the causes is poor alignment of the fibers; insufficient elongation at break of some resins is another cause. The application of prestresses on the unidimensional reinforcement of the laminates during resin cure gives better fiber alignment and puts the resin into compression. In these conditions the longitudinal shrinkage of the resin due to cure is no longer a problem. The resin can better follow the deformation of the glass fibers and this gives an appreciable increase in the strength of unidimensional laminates, the glass fibers of which can resist tensile stresses as high as 275 hectobars and even more. On a single impregnated yarn cured under prestress, a strength of 340 hectobars (493 000 lb/in_2) has been obtained. The general increase in strength is a function of the prestress applied. Author

N68-32294# Tyco Labs., Inc., Waltham, Mass.
INVESTIGATION OF THE GROWTH OF SINGLE CRYSTAL SiC BY THE TRAVELLING SOLVENT AND OTHER METHODS Final Report, 1 Jan.–31 Dec. 1967
B. N. Das, C. B. Lamport, A. I. Mlavsky, E. A. Trickett, and G. A. Wolff Apr. 1968 73 p refs
(Contract F19628-67-C-0186)
(AFCRL-68-0288; AD-671982)

The travelling heater method was used for the growth of alpha-and beta-SiC crystals in graphite crucibles. Molten chromium was used as a solvent material for the solution zone which was kept between 1650 and 1900 degrees C. Solid polycrystalline SiC ingots 0.3 cm in diameter and 2 cm in length have been obtained, with the individual crystals having a grain size of up to 1 mm. Polycrystalline ingots of alpha-and beta-SiC crystals have also been obtained by slow cooling of a molten alloy solution of Cr and SiC mixtures in graphite crucibles. SiC crystal growth from a beryllium containing solvent matrix was attempted by the travelling solvent method. Author (TAB)

N68-32307 State Univ. of New York, Brooklyn. Coll. of Ceramics.
SURFACE PROPERTIES OF TITANIA POWDERS
Martin B. Hanson (Ph.D. Thesis) 1967 149 p
Available from Univ. Microfilms: HC $7.00/MF $3.00 Order No. 67-13142

Experiments were performed on high surface area titania powders to determine what effect niobium doping has on the chemical and electrical constitution of these powders. These experiments included surface area, electrical conductivity, and magnetochemical measurements. An observed a.c. frequency dependence of the Arrhenius temperature coefficient of electrical resistance required development of an equivalent circuit technique for separation of conduction data into high and low frequency components, and yielded clearer insight into the actual sources of electrical conduction. The general characteristics determined for the powders studied are that vacuum reduction of pure titania powders created oxygen vacancies and an accompanying number of Ti^{+3} ions. In the case of niobium doping the presence of Ti^{+3} ions was reduced. The oxidizing effect of niobium on oxygen vacancies was suggested as a possible cause of this effect. Magnetic susceptibility measurements indicated electron spin pairing in niobium doped anatase powders. Dissert. Abstr.

N68-32342 Princeton Univ., N. J.
VISCOELASTIC PROPERTIES OF SEGMENTED ELASTOMERS AND HIGH TEMPERATURE POLYMERS
Stuart Leonard Cooper (Ph.D. Thesis) 1967 119 p
Available from Univ. Microfilms: HC $5.80/MF $3.00 Order No. 67-13486

Certain linear, amorphous polymers, specifically segmented polyester-urethanes, posses an unusually high level of modulus above their major glass transition temperature. This dissertation is an attempt to delineate a molecular mechanism to explain such behavior. By comparison of linear polyester-urethane systems with random and block butadiene-styrene copolymers, it was found that these polymers have alternating segments of stiff and rubbery molecules in the backbone of the polymer chain. Intermolecular association of both the hard and rubbery segments in the solid state produced the observed "enhanced modulus." This enhancement occurs because the associated harder blocks retain their glassy character above the major T_g of the copolymer, thereby providing reinforcement. Further information was obtained by chemical modification of segmented elastomers through plasticization and cross-linking. It was shown that plasticizer molecules can affect either the glassy or rubbery segments of the polymer depending on their chemical nature. Dissert. Abstr.

N68-32346 National Lending Library for Science and Technology, Boston Spa (England).
INFLUENCE OF WATERPROOFING RUTILE TITANIUM DIOXIDE ON ITS PHYSICO-TECHNICAL PROPERTIES [BLIYANIE GIDROFOBIZIROVANIYA RUTIL'NOI DVUOKISI TITANA NA EE FIZIKO-TEKHNICHESKIE SVOISTVA]

T. A. Ermolaeva, D. L. Abramson, N. S. Anufrieva, M. P. Potapova, and G. A. Prytkova. Jul. 1968. 9 p. refs. Transl. into ENGLISH from Lakokrasochnye Materialy i Ikh Primenenie (Leningrad), v. 6, 1967 p. 12–14
(RTS-4636) Available from Natl. Lending Library, Boston Spa, Engl.: 7s 6d

An aqueous emulsion of methyl-hydrogen-siloxane liquid GKZh-16 was used as a waterproofing compound for rutile titanium dioxides which were modified with hydrated compounds of aluminum, silicon, or zinc. The results show that the waterproofing of modified rutile leads to additional reduction of photochemical activity, improved dispersivity in binders, and increased sedimentation stability of enamels based on varnish PF-6. It was also found that the optimal quantity of GKZh-16 for treating rutile modified with aluminum and silicon compounds amounts to 0.25% to 0.5% of the pigment weight. Author

N68-32362# College of Aeronautics, Cranfield (England). Dept. of Materials.
STUDIES OF PURE HOMOGENEOUS DEFORMATIONS IN UNFILLED NATURAL AND BUTYL RUBBERS
M. M. Hall. Apr. 1968. 53 p. refs
(COA-NOTE-MAT-16) CFSTI: HC $3.00/MF $0.65

Observed deviations from the kinetic theory of rubberlike elasticity were reviewed, with emphasis on the Mooney parameter C_2. Stress measurements were made on thin rubber sheets in a state of pure homogeneous biaxial strain, and the stress relaxation behaviors of a natural rubber and a butyl rubber are reported. Analysis of the results allowed an examination of the stored energy function W over a strain invariant range $3 < I_1 < 12$ and $3 < I_2 \leq 30$. Finite values of $\delta W/\delta I_2$ were found under conditions for which there was no observed stress relaxation. This is at variance with the kinetic theory, for which $\delta W/\delta I_2$ is zero. Author

N68-32372# Naval Ordnance Lab., White Oak, Md. Chemistry Research Dept.
LITERATURE REFERENCES FOR MASSIVE GLASS FOR DEEP SUBMERGENCE
H. A. Perry and J. R. Fisher. 1 Jul. 1968. 84 p. refs
(NOLTR-68-31; AD-671867)

These literature references were assembled during exploratory developments on Massive Glass for Deep Submergence. This report is intended for use in the planning and implementation of work toward the development of Naval combat and support systems. Author (TAB)

N68-32448 Rutgers Univ., New Brunswick, N. J.
INTERATOMIC DISTANCES AND STABILITY OF STOICHIOMETRIC AND NON-STOICHIOMETRIC MAGNESIUM ALUMINATE SPINELS: AN ENERGETICS APPROACH
Robert Hullfish Arlett (Ph.D. Thesis) 1967. 119 p.
Available from Univ. Microfilms: HC $5.80/MF $3.00 Order No. 67-14691

The two main objectives are the explanation of the variation with composition of the crystal field parameter of transition metal ions on the tetrahedrally and octahedrally coordinated sites of the spinel structure, and the accounting for the asymmetry of solubility around the stoichiometric magnesium aluminate spinel. In order to adequately study these two objectives single crystal spinels were grown by the flame fusion technique at 1950° C. These crystals were doped with Co^{2+} and Cr^{3+} which occupy the tetrahedral and octahedral sites of the spinel structure respectively, in order to probe the variation of interatomic forces at these sites. The experimental methods employed were x ray diffraction and spectrophotometry. Both of the objectives above were achieved in terms of the crystal energetics approach. This approach enabled one to correlate the spectrophotometric results with the x-ray diffraction data. Dissert. Abstr.

N68-32517# Explosives Research and Development Establishment, Waltham Abbey (England).
THE EFFECT OF ADHESIVE THICKNESS ON JOINT STRENGTH
W. A. Dukes and R. W. Bryant. 4 Apr. 1968. 13 p. refs
(ERDE-S/M/68; AD-671863)

Although Wakes hypothesis requires a linear relation between the strength of a joint and the adhesive thickness, it is statistically preferable to describe our experimental data by relating either log strength or linear strength to log thickness. The predicted slopes or thickness-dependences of the joint strengths are at least three orders greater than those observed. However, Wake assumes adhesive failure at the interface, which was not observed in any of our experiments. Cohesive failure might well favour the following argument. Both the preferred relations (log/log and plain/log) between joint strength and adhesive thickness have a possible theoretical basis, in the analysis by extreme value statistics of the negatively skewed frequency distribution of tensile strengths (of rubbers), involving the frequency function of the maximum flaw. The former relation would hold if a Weibull type of distribution is used, and the latter if an exponential one. Thus it is possible that the dependence of joint strength on adhesive thickness is a consequence of the statistical basis of rupture. Author (TAB)

N68-32525# Naval Air Development Center, Johnsville, Pa. Aero Materials Dept.
EFFECT OF MIL-C-6799, TYPE 2, SPRAYABLE, STRIPPABLE, PROTECTIVE COATINGS ON PAINTED SUBSTRATES
D. Minuti. Jan. 1968. 10 p. refs
(NADC-MA-6805; AD-671811)

Strippable, sprayable, protective coating systems conforming to the Type II requirements of MIL-C-6799 were applied over test panels coated with paint systems currently used on Naval aircraft. The coated panels were exposed for 30 days to (1) a controlled temperature environment of 73F and 50% R.H. and (2) an outdoor exposure in the Philadelphia area. Upon termination of these exposures, the MIL-C-6799, Type II coatings were easily stripped with no adverse effect to the painted substrates. Author (TAB)

N68-32530 Akron Univ., Ohio.
TEAR BEHAVIOR OF FILLED AND UNFILLED ELASTOMERS
Arnold William Henry (Ph.D. Thesis) 1967. 193 p.
Available from Univ. Microfilms: HC $8.80/MF $3.00 Order No. 67-13146

A new method of preparing trouser-tear test-pieces has been investigated. It consisted of cementing thin, steel strips directly onto rubber sheets during vulcanization. The strips served to maintain essentially zero elongation in the trouser legs, and to provide a control over possible deviations of the tear tip from a linear path. The steel strip seperation was varied in different test-pieces from 0.001cm to 3.0cm. Carbon black-filled and unfilled vulcanizates of an amorphous elastomer (SBR) and a strain-crystallizing elastomer (NR) were the primary materials tested over a range of temperatures and tear rates. The experiments with NR filled and unfilled elastomers revealed again the similarity in tear resistance of the closely-spaced filled and unfilled samples. Dissert. Abstr.

N68-32576 Princeton Univ., N. J.
PROPERTIES OF POLYURETHANES AND IONOMERS
Thomas Carl Ward (Ph.D. Thesis) 1967. 196 p.
Available from Univ. Microfilms: HC $9.00/MF $3.00 Order No. 67-13514

Several types of polyurethane gels were prepared using both commerical prepolymers and macroglycol starting materials. Under certain conditions gels based on isocyanate terminated polyester-diols were obtained which had chemical stress-relaxation rates much slower than the urethane bond cleavage rate. These gels had low extensibilities and relatively high moduli at elevated temperatures. Corresponding gels from polyether-diols could not be prepared. Oxidative scission of the network chains was a negligible contributor to the stress relaxation under the conditions employed. The viscoelastic behavior of ionomers was investigated. Master curves for stress relaxation on ionomers containing different cations, degrees of ionization, and amounts of annealing were obtained. The viscoelastic behavior was discussed in terms of a recently proposed model for ionomers and found to be consistent. In this model the per cent of ionization acts as a regulator for the growth of oriented lamellar regions which surround ionic pockets. Dissert. Abstr.

N68-32580 National Lending Library for Science and Technology, Boston Spa (England).
COMPOSITE MATERIALS AND THEIR APPLICATION FOR ELECTRICAL CONTACTS [VERBUNDWERKSTOFFE UND IHRE ANWENDUNG FUER ELEKTRISCHE KONTAKTE]
Horst Schreiner 15 Dec. 1967 17 p refs Transl. into ENGLISH from Z. Metallk. (Stuttgart), v. 58, Sep. 1967 p 600-606 In GERMAN and ENGLISH
(EE-TRANS-1714) Available from Natl. Lending Library, Boston Spa, Engl.

As an introduction, a definition and survey of composite materials is indicated. These important compound materials for electrical contacts belong to the systems metal/metal, metal/intermetallic combination and metal/metaloid. Of the systems metal/metal, the most important inclusion composites are represented by silver-nickel alloys containing 10% to 40% nickel and silver-tungsten alloys containing 10% to 90% tungsten. The most important diffusion composites are represented by copper tungsten alloys containing 50% to 80% tungsten. Of the systems metal/metal combination compounds the inclusion composites silver CdO containing 5% to 15% CdO and silver tungsten carbide containing 60% to 80% WC are discussed. Of the systems metal/metaloid the glide constants copper graphite and the switching contacts silver graphite containing up to 10% carbon are mentioned. Apart from the production procedures, the properties of these composite materials and their applications are described. Particular emphasis is given to the relations between microstructure and contact properties. Author

N68-32649 Alfred Univ., N. Y. Coll. of Ceramics.
THE ELASTIC PROPERTIES OF OXIDE SOLID SOLUTIONS: THE ALUMINUM OXIDE-CHROMIUM OXIDE SYSTEM
Louis Robert Rossi (Ph.D. Thesis) 1967 79 p
Available from Univ. Microfilms: HC $4.20/MF $3.00 Order No. 67-13143

Fine grained chromium oxide, aluminum oxide and coprecipitated mixtures of the two were hot pressed into dense, polycrystalline specimens. The longitudinal and shear sound velocities of these specimens were measured by the method of ultrasonic interferometry. The densities of each specimen were determined by the Archimedes method. The lattice parameters for this system were measured with the X-ray diffractometer, and the X-ray density for each composition calculated. Both sound velocities for each composition were corrected for porosity effects. Microstructural examinations on several of the solid solution compacts revealed average grain sizes of 10-12μ. Small anelastic effects were found to exist in the composition 78.9 mol % Cr_2O_3 - 21.1 mol % Al_2O_3 by measuring the slope, dV_L/dT, in the vicinity of room temperature. These effects were related to the antiferromagnetic character of Cr_2O_3. The measured lattice parameters were compared to those predicted by Vegard's law and Friedel's model. Dissert. Abstr.

N68-32660# Aerospace Corp., El Segundo, Calif. Lab. Operations.
ON THE USE OF PHOSPHORESCENCE QUENCHING FOR DETERMINING PERMEABILITIES OF POLYMERIC FILMS TO GASES
Peter F. Jones 10 May 1968 16 p refs
(Contract F04695-67-C-0158)
(TR-0158(9250-01)-5; SAMSO-TR-68-239; AD-671527)

By measuring the lifetime of the phosphorescence of an additive in a polymeric film as a function of the ambient pressure of a quenching gas, it is possible to calculate the permeability of the polymer to the quenching gas. The mathematical analysis is based upon the well-known steady-state diffusional quenching theory. From the oxygen quenching of the phosphorescence of naphthalene additive, a permeability of poly(methylmethacrylate) to oxygen of (1.1 plus or minus 0.2) x 0.0001 sq.cm./sec.mole/1/mm was calculated. Author (TAB)

N68-32680 National Lending Library for Science and Technology, Boston Spa (England).
THE BULK POLYMERISATION OF VINYL MONOMERS AT HIGH DEGREES OF CONVERSION [POLIMERIZATSIA VINILNIKH MONOMEROV V MASSE PRI GLUBOKIKH STEPENYAKH PREVRASHCHENIYA]
G. P. Gladishchev and S. R. Rafikov Mar. 1968 38 p refs Transl. into ENGLISH from Usp. Khim. (Moscow), v. 35, 1966 p 918-937
(RTS-4462) Available from Natl. Lending Library, Boston Spa, Engl.: 40s

Gel effect theory, chain transfer reactions, and theoretical and other investigations are reviewed in relation to the bulk polymerization of vinyl monomers. Quantitative data from the literature is reported for a variety of compounds, including butyl acrylate, methylacrylate, methylmethacrylate, styrene, and vinyl acetate. Elementary processes at large degrees of conversion are discussed, and various formulas for the quantitative interpretation of results are included. M.W.R.

N68-32736 Alfred Univ., N. Y. Coll. of Ceramics.
NUCLEATION AND CRYSTALLIZATION OF GLASSES IN A PORTION OF THE BARIUM OXIDE-BORON OXIDE-ALUMINUM OXIDE SYSTEM
Richard Lee Wahlers (Ph.D. Thesis) 1967 155 p
Available from Univ. Microfilms: HC $7.20/MF $3.00 Order No. 67-13141

Additions of rhodium to certain glasses in the $BaO-B_2O_3-Al_2O_3$ (Ba-B-Al) system and proper heat treatment of these glasses initiate glass-ceramic formation. Study of the crystallization of glasses without nucleating agents consisted of determining the phase equilibrium diagram in the region of interest and observing the nature of the nucleation and crystallization of these glasses. This study revealed five new crystal phases. The possible stoichiometries of the phases are discussed and their optical and x-ray properties are tabulated. In the study of crystallization of Ba-B-Al glasses with nucleating agents, the influence of the following factors on glass-ceramic formation was determined: (1) initial glass composition, (2) melting schedule, (3) nucleation catalyst type, (4) nucleation catalyst concentration, and (5) crystallizing treatment. The initial stages of glass-ceramic formation were studied with an electron microscope. Dissert. Abstr.

N68-32805 Rutgers Univ., New Brunswick, N. J.
STUDY OF THE CRYSTALLIZATION OF A BARIA-TITANIA-BORIC OXIDE GLASS

David Thomas Rankin (Ph.D. Thesis) 1967 96 p
Available from Univ. Microfilms: HC $5.00/MF $3.00 Order No. 67-14749

A study of the crystallization of a baria-titania-boric oxide glass was made with particular interest centered on the devitrification of barium titanate. A rapid quenching technique was needed to form the composition into thin glass sheets since it contained a minimum of glass former. Controlled devitrification of the glass was induced in a subsequent heat treatment. Various conventional techniques, as well as a special viscosity measuring technique, were used to follow the course of crystallization. This special technique allowed viscosity measurements in the annealing range to be made independant of the dimensions of the sample. This method essentially compares the room temperature twist or elastic distortion of a fiber to the rate of change of the twist caused by viscous flow at elevated temperatures. Dissert. Abstr.

N68-32898# Boeing Scientific Research Labs., Seattle, Wash. Polymer Lab.
NOVEL THERMALLY STABLE AND CHEMICALLY RESISTANT EPOXY POLYMERS DERIVED FROM PHENYLENE OXIDES
Roy G. Neville, John W. Mahoney, and Kenneth R. MacDowall Nov. 1967 28 p refs
(D1-82-0681; AD-671969)

Thermogravimetric and differential thermal analysis data are presented for three novel bis-epoxy monomers and formulated coatings derived therefrom. The coatings were insensitive to impact in liquid oxygen and showed excellent resistance to liquid nitrogen tetroxide, concentrated nitric acid, and a variety of organic solvents. All coatings showed excellent adhesion to metals, and oxidation resistance superior to any known commercial epoxy polymer. Thermal resistance was excellent at 500F for periods of at least 500 hours in air. Other data on these novel epoxy polymers are also presented. TAB

N68-32957# Pennsalt Chemicals Corp., King of Prussia, Pa.
THE USE OF POLY(METAL PHOSPHINATES) AS ANTISTATIC COATINGS, MULTI-PURPOSE FLUID THICKENERS, AND THERMALLY STABLE COATINGS Final Report, 16 Feb.–15 Nov. 1967
G. H. Dahl, O. S. Sprout, Jr., N. D. Peschko, and B. P. Block Mar. 1968 37 p refs
(Contract N00156-67-C-1783)
(AD-671882)

Water-repellant and transparent plasticized poly(metal phosphinate) compositions were developed for antistatic coatings on polyethylene. Coatings based on Cr(H2O) (OH) (OPBu2O)2, Cr(H2O) (OH) (OP(Me) (Ph)O)2, Cr(H2O) (OH)(OPPh2O)2, and TiO(OPPh2O)2 all dissipated a 5 kV positive charge in one second or less. Coatings based on TiO(OPPh2O)2 also dissipated a 5 kV negative charge in one second or less and were essentially not tacky. The tris(phosphinate) Cr(OP(C8H17)2O)(OP(Me)(Ph)O)2 prepared in situ was found to be an effective thickener for a variety of lubricant fluids in the 5-14% concentration range. A thickener with substantially greater thermal stability was prepared by the reaction of Cr(H2O) (OH)(OP(Me)(Ph)O)2 with Me(Ph)P(O)OH. Greases made from DC550 and these thickeners exhibit drop points generally above 500F, and good antiwear properties; however, their bearing performance is limited. Coatings of Cr(OP(C8H17)2O)(OP(Me)(Ph)O)2 pigmented with TiO2 adhere well to cold-rolled 1010 steel and exhibit good hardness and resistance to jet oil or water. They can tolerate 250C in air for one hour but degrade at 300C. The use of more stable chromium(III) tris(phosphinates), i.e., tris(phosphinates) containing no alkyl groups other than methyl, for coatings was briefly explored. Author (TAB)

N68-33034*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
EFFECT OF FILM PROCESSING ON CRYOGENIC PROPERTIES OF POLY(ETHYLENE TEREPHTHALATE)
Roger E. Eckert and Tito T. Serafini Washington Aug. 1968 35 p refs
(NASA-TN-D-4762) CFSTI: HC $3.00/MF $0.65 CSCL 11I

The effects of stretch temperature, heat-set temperature, and time on the cryogenic mechanical properties of PET film were studied by using a two-level factorial experiment. Amorphous PET sheet was oriented at either 85° or 95° C. The levels of heat-set temperature and time investigated were 190° and 210° C and 15 and 120 seconds, respectively. Film crystallinity was determined by the density gradient technique. Tensile properties were measured in liquid nitrogen and in liquid hydrogen. Biaxial burst properties were obtained in liquid nitrogen. The number of flexural cycles to failure in liquid hydrogen and room-temperature gas porosities after 25 such cycles were also determined. Author

N68-33085*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
EFFECTS OF CROSS-LINK DENSITY AND POLYMER STRUCTURE ON THERMAL ANALYSIS OF PHENOL-FORMALDEHYDE POLYMERS
Ernest L. Winkler and John A. Parker [1968] 16 p refs Presented at the 2d Intern. Conf. on Thermal Analysis, Worcester, Mass., 18–23 Aug. 1968
(NASA-TM-X-61168) CFSTI: HC $3.00/MF $0.65 CSCL 11I

A mechanism has been proposed for the pyrolysis of a phenolic novolak through a set of concerted reactions following the general mechanism for cross-linked polymers. These mechanisms are consistent for the kind of polymer to which they are applied. Examination of the pyrolysis products for novolaks and resols, and comparison of their infrared spectra led to the conclusion that the structures of resols and novolaks are different. Cross-link density in a phenolic novolak was varied over a broad range by varying the quantity of hexamethylene-tetramine used in the cure. By using this technique, the rearrangement and cross-linking reactions were sufficiently separated to determine the thermokinetic parameters for each reaction by thermogravimetry. When these kinetics were combined with those for the pyrolysis of nylon, a thermogram was constructed for the composite and it agrees well with experiment. It is suggested that variations of the method are applicable to a broad class of cross-linked polymers. Author

N68-33100# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
DURABILITY OF POLYMER FIBERS AND FILMS UNDER STRESS WHEN SUBJECTED TO ULTRAVIOLET IRRADIATION [DOLGOVECHNOST' PO LIMERNYKH VOLOKON I PLENOK V NAPRAZHENNO SOSTOYANII PRI VOZDEYSTVII UL'TRAFIOLETOVOGO OBLUCHENIYA]
V. R. Regel' and N. N. Chernyy 29 Aug. 1967 13 p refs Transl. into ENGLISH from Khim. Volokna (Leningrad), no. 6, 1965 p 50–54
(FTD-HT-23-822-67; AD-671732)

The effect of ultraviolet light on the strength of stressed polymeric fibers and films was examined. Sixteen different polymeric materials exhibited identical characteristics with respect to the relationship of their durability when under stress and subjected to UV light. An empirical equation was found. This relationship is explained by the superimposition of two breakdown processes--a fluctuation process and the process of destruction due to the action of light. Specific physical terms can be attached to the parameters of the empirical equation. This empirical relationship can be used in determining light stability of stressed polymers. Author (TAB)

N68-33123# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
CREEP OF SVAM AT ROOM TEMPERATURE [O POLZUCHESTI CBAM PRI NORMAL'NOY TEMPERATURE]
P. M. Ogibalov and I. M. Tyunyeyeva *In its* Moscow Univ. Herald. Ser. 1: Math., Mech., No. 2, 1964 6 Jun. 1967 p 63–68 refs (See N68-33115 20-19)

The mechanical properties of the fiber glass reinforced plastic SVAM are studied. Transient creep and elastic recovery have been investigated experimentally. Author

N68-33124# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
THEORETICAL ANALYSIS OF EXPERIMENTAL DATA ON THE ELASTIC AFTEREFFECT OF FIBERGLASS PLASTICS [TEORETICHESKAYA OBRABOTKA EKSPERIMENTAL'NYKH DANNYKH OB UPRUGOM POSLEDEYSTVII STEKLOPLASTIKOV]
P. M. Ogibalov and I. M. Tyunyeyeva *In its* Moscow Univ. Herald. Ser. 1: Math., Mech., No. 2, 1964 6 Jun. 1967 p 69–74 refs (See N68-33115 20-19)

The theoretical treatment of experimental data on fiber glass reinforced plastics KAST-V, textolite, SVAM is given. Use is made of Maxwell's formula generalized by G. I. Gurevich. Author

N68-33154# Rocketdyne, Canoga Park, Calif.
OXYGEN-DEFICIENT ZIRCONIA AND THORIA: THEIR THERMAL SHOCK RESISTANCE AND EQUILIBRIUM OXYGEN PRESSURE Final Report, Jun. 1965–May 1968
T. F. Schroeder, S. C. Carniglia, and S. D. Brown 24 Jun. 1968 46 p refs
(Contract DA-31-124-ARO(D)-376)
(R-7525; AROD-5717-2-MC; AD-671690)

Initial studies revealed that oxygen-deficient zirconia and thoria are more resistant to thermal shock conditions than the corresponding stoichiometric materials. This program was undertaken to explore and elucidate this phenomenon. To accomplish this objective, the elastic modulus (E), thermal expansion (a), and strength (s) were determined for both the oxygen-deficient and stoichiometric materials, and the ratios s/Ea were compared. Also, replicas of fracture surfaces resulting from thermal shock were studied by electron microscopy. In general, it was found that the increased resistance to thermal shock exhibited by the oxygen-deficient material is not due to any intrinsic differences caused by the oxygen deficiency. Rather, it appears that the metal phase precipitated in the grain boundaries of the oxygen-deficient material provides better intergranular bonding and a means of inhibiting crack propagation to give improved strength. The equilibrium pressure of oxygen over zirconia and thoria was measured over the temperature range 1000-1900C, and the location of the ZrO2-x - Zr boundary was determined microscopically. The results of these measurements are discussed in terms of thermodynamics. Author (TAB)

N68-33237# Los Alamos Scientific Lab., N. Mex.
EVALUATION OF YTTRIA IN MOLTEN BARIUM AND LITHIUM
Edward S. Keddy 17 May 1968 9 p refs
(Contract W-7405-ENG-36)
(LA-3822-MS) CFSTI: HC $3.00/MF $0.65

Yttria were tested for possible use in high-temperature thermionic converters. Specimens of 98.7% Y_2O_3 withstood 1000 hr at 1000° C in vacuo, but disintegrated when refired to 2000° C. Similar specimens failed after having been immersed in molten Ba or molten Li when heated to 1000° C. Samples of 99.5% Y_2O_3 withstood all the tests in good condition although some surface attack after Ba or Li immersion indicated limited use in such an environment. Impurities affect the heat resistance of Y_2O_3 significantly and must be held to a minimum if Y_2O_3 is to be used in high-temperature thermionic converters. Author (TAB)

N68-33293*# West Virginia Univ., Morgantown. Engineering Experiment Station.
DEVELOPMENT OF CONSTITUTIVE EQUATIONS FOR NUCLEAR GRADE GRAPHITE FOR SPACE APPLICATIONS 2 Final Report
Robert D. Snyder Aug. 1968 121 p refs
(Grant NsG-533)
(NASA-CR-96377; Rept.-863109454(J-S) CFSTI: $3.00 CSCL 11B

The object of this investigation was to develop a general constitutive equation for the room temperature mechanical response of nuclear grade graphite. The distinguishing characteristics of this response are (1) the stress-strain relation appears to be independent of the rate of loading short of impact rates; (2) the response exhibits a pronounced degree of transverse isotropy; and (3) the material undergoes permanent plastic deformation even at the lowest stress levels. The greatest portion of this report is devoted to the derivation of constitutive relations for the scalar and three dimensional cases. The scalar theory succeeds in demonstrating rate independence and plasticity while the three dimensional theory incorporates transverse isotropy. The scalar theory provides an excellent correlation with experiment while the three dimensional theory gives a reasonably good conservative correlation. Author

N68-33303*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
THERMAL DEGRADATION ANALYSIS OF POLYMERIC MATERIALS BY COMBINED MASS SPECTROMETRIC AND THERMOGRAVIMETRIC ANALYSIS
Donald E. Wilson and Frank M. Hamaker Aug. 1968 30 p refs Presented at the 2d Intern. Conf. on Thermal Analysis, Worcester, Mass., 18–23 Aug. 1968
(NASA-TM-X-61159) CFSTI: HC $3.00/MF $0.65 CSCL 11I

A method that combines mass spectrometry with thermogravimetric analysis (MS-TGA) is presented that gives rapid and quantitative results for the parameters of thermal degradation of polymeric materials. This MS-TGA analysis permits following the course of any reaction that produces gaseous products by measuring the rate of evolution of these products. Results thus obtained are compared with calculations obtained by more conventional techniques for a number of polymers. The MS-TGA technique is considered suitable for a program that characterizes new materials, and it can provide for evaluating these materials on both the practical and scientific levels. The rapid determination of the kinetic parameters of thermal degradation by the technique and the identification of the degradation products as well as the temperature range over which they occur can be used for predicting the thermal behavior of a material as well as for suggesting guidelines for the synthesis of new materials. M.W.R.

N68-33324# Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.
VISCOELASTIC EVALUATION OF SILICON RUBBER AND ETHYLENE PROPYLENE
N. R. Gordon 17 May 1968 32 p refs
(Contract AT(45-1)-1830)
(BNWL-736) CFSTI: HC $3.00/MF $0.65

Initial evaluation studies were made on two materials to determine their suitability as alternates to a silicone rubber for reactor applications. Of the two materials studied, ethylene propylene and chlorosulfonated polyethylene, the ethylene propylene has the

lowest compression set and stress relaxation; and consequently, appears to be the best candidate. It has a higher stress relaxation rate than the silicone but its radiation resistance is superior. Author (NSA)

N68-33325# Mound Lab., Miamisburg, Ohio.
TAP DENSITY VALUES FROM IRREGULAR BORON PARTICLES
J. W. Voigt 22 Apr. 1968 1968 16 p refs
(Contract AT(33-1)-GEN-53)
(MLM-1458) CFSTI: HC $3.00/MF $0.65

A study was made of the packing characteristics for irregular shaped particles of crystalline boron ranging between the limits of 20 to 105 μ. The material was divided into seven size groups ranging in magnitude from 8 to 17 μ. These groups were checked first through a series of similar tests to determine the rate of packing and the apparent maximum density. The study includes an investigation of the possible effects on tap density values when different parent pellets were used. The study also covers the effects of sample quantity on the apparent maximum tap density and includes the results from varying the mixture of two size groups over a range of percentage composition. The study generally revealed many of the same packing characteristics as those found for spheres; the maximum density values were several percentage points lower and seemed to vary with particle size. The density values seemed to fluctuate within a narrow range instead of packing to consistently repeated values. Author (NSA)

N68-33601 National Lending Library for Science and Technology, Boston Spa (England).
POLYAMIDE 6 WITH FINE CRYSTALLINE STRUCTURE
W. Zielinski 11 Sep. 1967 13 p refs Transl. into ENGLISH from Polimery (Warsaw), v. 11, 1966 p 504–507
(M-7061) Available from Natl. Lending Library, Boston Spa, Engl.

Discussed are: the morphological structure of polyamide 6 (polycaprolactam) used for injection moulding; the dependence of polyamide 6 dimensions upon moisture; mechanical, thermal, and electrical properties of polyamide 6; the influence of the degree of crystallinity on the properties of polyamide 6; processing methods for fine crystalline structure polyamide 6; applications of polyamide 6 with fine crystalline structure; and European manufactures producing polyamide 6 with fine crystalline structure. S.C.W.

19 MATHEMATICS

Includes calculation methods and theory; and numerical analysis. For applications see: 08 Computers.

N68-32235 National Lending Library for Science and Technology, Boston Spa (England).
GONCHAROV'S POLYNOMIALS AND PROBLEMS OF REPRESENTING AN ANALYTICAL FUNCTION BY A SERIES OF PRIMITIVES OF SOME FUNCTION [POLINOMY GONCHAROVA I VOPROCY PREDSTAVLENIYA ANALITICHESKOI FUNKTSII RYADOM PO PERVOOBRAZNYM NEKSTOROI FUNKTSII]
Yu. A. Kaz'min Nov. 1967 20 p refs Transl. into ENGLISH from Vestn. Mosk. Univ. (Moscow), v. 6, 1962 p 9–19
(RTS-3987) Available from Natl. Lending Library, Boston Spa, Engl.: £1 7s 6d

Conditions are studied under which the sequence of primitives of a certain function $f(z) \in A_R$ forms a base in the space of functions (A_R) that are regular in the circle $|z| < R$. The use of Goncharov's polynomials for such a problem is considered, and two quasi power bases within the circle are indicated. The polynomials are expanded, and several theorems are proved that relate to problems of representing an analytic function by a series of primitives of some function and the resultant base formed from the primitives. M.W.R.

N68-32325# Air Force Cambridge Research Labs., Bedford, Mass.
A MULTIVARIABLE INTERPOLATION FORMULA
John A. Pustaver, Jr. May 1968 18 p refs *Its* Phys. Sci. Res. Papers, No. 358
(AFCRL-68-0284; AD-671485)

The paper presents a method for interpolation between given data points in n-dimensional space. Given the values and partial derivatives of a function for a set of points on an n-dimensional grid, an interpolation formula can be constructed which is exact for the values and partial derivatives at the given points. When the partial derivatives are not known, they can be approximated by the spline fit method which is described in Appendix A. Author (TAB)

N68-32392# RAND Corp., Santa Monica, Calif.
AN INITIAL VALUE THEORY FOR FREDHOLM INTEGRAL EQUATIONS WITH SEMIDEGENERATE KERNELS
H. M. Kagiwada and R. E. Kalaba Apr. 1968 21 p refs
(Contract F44620-07-C-0045)
(RM-5602-PR; AD-671483)

An initial-value method for solving Fredholm integral equations having a kernel with one degenerate form in one region and another degenerate form in another region. Fredholm equations having kernels of the type considered here are of particular interest because of their pertinence to the solution of two-point boundary problems. When such a problem is reformulated as an integral equation, the kernal is a Greens function having one form in one region and another form in another region. The Greens function may be first determined and then approximated to the desired degree of accuracy by a semidegenerate kernel. Volterra equations are also considered as a special case, and some discussion of critical lengths and eigenvalues is provided. Author (TAB)

N68-32619# Wisconsin Univ., Madison. Mathematics Research Center.
ON SPLINE INTERPOLATION AT ALL INTEGER POINTS OF THE REAL AXIS
I. J. Schoenberg Nov. 1967 23 p refs
(Contract DA-31-124-ARO(D)-462)
(MRC-TSR-828; AD-671606)

The spline functions of degree 2m-1 which solve the interpolation F(nu) = Y sub nu (for all integers nu) (Quart. Appl. Math., 4(1948)) are here characterized by certain extremum properties. Also their behavior is studied as m approaches infinity. Author (TAB)

N68-32642# New York Univ., N. Y. Courant Inst. of Mathematical Sciences.
RESIDUE EXPANSIONS FOR CERTAIN GREEN'S FUNCTIONS AND RESOLVENT KERNELS
Arthur S. Peters Apr. 1968 53 p refs
(Contract Nonr-285(55))
(IMM-366; AD-671798)

The report is concerned with the expansion of an arbitrary function in terms of the generalized eigenfunctions defined by d/dx p(x) d/dx psi(x, lambda) + q(x)psi - lambda r(x)psi = 0, 0 < x < 1; subject to the boundary conditions psi sub x (0, lambda) + beta sub zero psi(0, lambda) = alpha sub zero lambda psi(0, lambda), psi sub x(1, lambda) + beta sub one psi(1, lambda) = alpha sub one lambda psi(1, lambda). The expansions stem from the Poincare-Birkhoff formula. Author (TAB)

N68-32658# RAND Corp., Santa Monica, Calif.
ANOTHER OPTIMAL STOPPING PROBLEM
Thomas A. Brown Sep. 1967 10 p refs
(P-3635)

Assuming that an experimenter taking observations X_1, X_2 ... sequentially from a given population knows (1) that the population on which he makes observations will be rectangular; (2) that it will range from 0 to an unknown value which has an a priori rectangular distribution ranging from 0 to k, where $k = 1$; and (3) that each observation costs a fixed amount c, an optimal stopping rule is developed which terminates the experiment whether the largest observed X is small or large. S.C.W.

N68-32696# California Univ., Berkeley. Dept. of Mathematics.
PARTIAL DIFFERENTIAL EQUATIONS, OPERATOR THEORY AND APPLICATIONS Final Status Report, 1 Oct. 1963–14 Jun. 1968
Murray H. Protter Jul. 1968 10 p refs
(Grant AF-AFOSR-553-64)
(AFOSR-68-1579; AD-671976)

The senior investigators on this grant have been active in the following subjects: Cordes has been working on algebras of operators which include partial differential operators as special cases. In particular, he has made detailed investigations of the symbol of a pseudo-differential operator. Kato has concerned himself with problems in scattering theory, its generalizations in functional analysis, and various applications to partial differential equations. He has also obtained results on the nonstationary flow of viscous fluids. Lehman studied extensions of the sloping beach problem and related mixed boundary value problems which arise in electromagnetic diffraction theory. He has also used sophisticated computer techniques to study the first 250,000 zeros of the Riemann zeta-function. Miller has investigated the approximation of solutions of problems in partial differential equations when the data are ill-posed. He has also studied regular and irregular boundary points of solutions of elliptic differential equations. Protter has employed the maximum principle to obtain results on the capacity of conductors and estimates for the spectrum of elliptic operators. He has also studied the relation of difference equations to the functional form of solutions of differential equations. Author (TAB)

N68-32740 National Lending Library for Science and Technology, Boston Spa (England).
TOPOLOGY CONTROLLED ELIMINATION ALGORITHMS IN LOAD FLOW ANALYSIS
R. Baumann 20 Jun. 1968 16 p refs Transl. into ENGLISH of the Rept. of Tech. Hochschule, Munchen, p 1–18 /ts Transl. No. 4738
Available from Natl. Lending Library, Boston Spa, Engl.

Since the convergence of nodal iterative processes is rather poor, basic load flow equations are mostly solved by elimination algorithms. Topological control may help to improve the efficiency of these methods but requires either (1) pre-ordering the rows and columns of the node admittance matrix; (2) selection of a distinct variant of elimination; or (3) sequence of pivotal elements. By means of item (1) the admittance matrix may be given a shape clearly expressing the structure of the network, by means of (3) either the storage requirement and/or the number of operations during the process can be reduced to a minimum. Author

N68-32799# Information Research Associates, Inc., Lexington, Mass.
LEAST SQUARES FIT TO THE OPTIMUM (BAYES') DECISION SURFACE
A. R. Williams, W. N. Furey, and D. S. Brick 9 Feb. 1968 23 p
(Contract Nonr-4752(00))
(IRA-TR-16; IRA-100-26; AD-671908)

A procedure for the determination of a high-order polynomial decision surface is presented. The procedure is based on the least squares fitting of polynomials to the optimum (Bayes) decision surface. The weighting function required for the least squares procedure is constructed so that the resulting polynomial decision surface will minimize an approximation to the risk of misclassification. The least squares procedure is compared in both theory and simple application to a similar procedure due to Specht which is based on a Taylor series approximation to the Bayes solution. It is shown that the least squares procedure yields significantly superior results in some situations. Author (TAB)

N68-32821# Applied Physics Lab., Johns Hopkins Univ., Silver Spring, Md.
A PRIORI ESTIMATE AND SOME PROPERTIES OF SOLUTIONS OF ELLIPTIC AND PARABOLIC EQUATIONS
S. N. Kruzhkov Apr. 1968 62 p refs Transl. into ENGLISH from Mat. Sb. (Moscow), v. 65, no. 107, 1964 p 522–570
(Contract NOw-62-0604)
(APL-CLB-3-T545; AD-671577)

In this paper we establish a priori estimates and costudy certain qualitative properties of generalized solutions of second-order elliptic and parabolic equations. The first fundamental results in this direction for equations with many independent variables were established in the papers by de Giorgi and Nash. A refined new approach to the consideration of similar problems and, in particular, a new proof of the de Giorgio theorem were given by Moser. In the present paper the method proposed by Moser is expanded. TAB

N68-32924# Carnegie-Mellon Univ., Pittsburgh, Pa. Dept. of Computer Science
ON CANONICAL FORMS AND SIMPLIFICATION
Bobby Forrester Caviness (Ph.D. Thesis) May 1968 86 p refs
(Contract ARPA SD-146)
(AD-671938)

The purpose of the dissertation was to study the representations of formula expressions in a way that would give meaning to the so-called simplification problem. TAB

N68-32925 National Lending Library for Science and Technology, Boston Spa (England).
ON THE "TAG" PROBLEM OF E. L. POST [O "TAG" PROBLEME E. L. POSTA]
S. Yu. Maslov Mar. 1968 18 p refs Transl. into ENGLISH from Tr. Mat. Inst., Akad. Nauk SSR (Moscow), no. 72, 1964 p 57–68
(RTS-4422) Available from Natl. Lending Library, Boston Spa, Engl.: 30s

Previous data on the Tag or T_1 system are discussed, along with some algorithmical problems connected with this concept. Also considered is a method which makes it possible to construct for each natural number, which is not a multiple of a prime number, and for each Turing machine an equivalent T_1 system with a natural number of positions. Theorems are derived to prove that it is possible, for any number of positions greater than one, to construct a specific T_1 system with that number of positions in which both types of the Tag problem remain unresolved. It is pointed out that in a T_1 system with only one position, both types of the Tag problem can be solved. For simplification, the T_2 system concept is introduced. M.G.J.

N68-32961 National Lending Library for Science and Technology, Boston Spa (England).
A METHOD OF OBTAINING ANALYTICALLY THE DERIVATIVE OF A FUNCTION GRAPHICALLY GIVEN

Bruno Maione 14 Mar. 1968 4 p Transl. into ENGLISH from Autom. e Struct. (Italy), v. 15, no. 7, Jul. 1967 p 310–311
(TRANS-2454) Available from Natl. Lending Library, Boston Spa, Engl.

Consideration is given to the problem of finding a suitable analytical expression which approximates to the derivate of a function given in the form of a graph. Attention is focused on a case which it is desired to associate analytical expressions corresponding to a truncated orthonormal series with the function and its derivatives. It is shown how the coefficients of the complete series of the derivative can be expressed using the results of calculations already made to evaluate the coeficients of the function. B.S.D.

N68-32986# Northwestern Univ., Evanston, Ill.
A DECISION PROCEDURE BASED ON THE RESOLUTION METHOD
Bruce Kalllick [1968] 16 p refs Presented at the IFIP Congr. 68, Edinburgh, 5–10 Aug. 1968
(Grant AF-AFOSR-1125-66)
(AFOSR-68-1584; AD-671994)

A decision procedure for satisfiability of predicate calculus formulas in the AAE prefix class is described. The procedure is a hybrid based on J. Friedmans decision procedure and on J. A. Robinsons resolution method. It most resembles the latter parent, in that resolvent clauses are formed from the clauses of a formula expressed in conjunctive normal form and from other resolvent clauses until two complementary one-literal clauses resolve into the empty clause. Unlike the general resolution method, however, the procedure does not generate literals with nested Skolem functions. There is, therefore, a bound on literal length and the procedure terminates even if the empty clause is not generated.
Author (TAB)

N68-33058# Wisconsin Univ., Madison. Mathematics Research Center.
APPROXIMATION BY PERIODIC SPLINE INTERPOLANTS ON UNIFORM MESHES
Michael Golomb Jun. 1967 58 p refs
(Contract DA-31-124-ARO(D)-462)
(MRC-TSR-788; AD-671604)

Explicit formulas for approximate interpolation, differentiation, integration, and Fourier coefficients, based on interpolation by polynomial splines on uniform meshes, are given. Precise approximation errors, derived from Fourier series expansions, are established. Author (TAB)

N68-33059# Wisconsin Univ., Madison. Mathematics Research Center.
DIFFERENTOIDS
Eduardo H. Zarantonello Aug. 1967 174 p refs
(Contract DA-31-124-ARO(D)-462)
(MRC-TSR-771; AD-671603)

A differentioid is the sum of a differential operator with C(superscript infinity symbol)-coefficients and an integral operator with a kernel that, up to terms of arbitrary degree of smoothness, is a finite sum of the form Summation F(x,y)/ /xy/ raised to the power alpha (F(x,y) epsilon C(superscript infinity symbol, / /=geodesic distance). Differentioids form a graded algebra endowed with a symbol; they coincide with the operators admitting asymptotic expansions in terms of multipliers and powers of the basic differential operators. Author (TAB)

N68-33102# Boeing Scientific Research Labs., Seattle, Wash. Mathematics Research Lab.
LIFTING PROJECTIONS OF CONVEX POLYHEDRA
David W. Walkup and R. J.-B. Wets Apr. 1968 20 p refs
/its Mathematical Note No. 553
(D1-82-0714; AD-671427)

Briefly, if T is a projection of a closed polyhedron P onto a polyhedron Q, then a lifting of Q into P is defined to be a single-valued inverse T* of T such that T*(Q) is the union of closed faces of P. The main result of this paper, called the Lifting Theorem, asserts that there always exists a lifting T*, provided only that there exists at least one face of P on which T acts one-to-one. The Lifting Theorem is seen as a unifying generalization of a number of results in the theory of convex polyhedra and has important applications in the theory of mathematical programming. In the course of proving the Lifting Theorem a result on linear programs of interest in its own right is proven, namely, that the optimal solution of a linear program can be chosen so that it is a continuous function of the right-hand sides. Author (TAB)

N68-33115# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
MOSCOW UNIVERSITY HERALD. SERIES 1: MATHEMATICS, MECHANICS, NO. 2, 1964 (COLLECTION OF ARTICLES)
6 Jun. 1967 138 p refs Transl. into ENGLISH of Vestn. Mosk. Univ., Ser. 1, Mat., Mekhan (Moscow), no. 2, Mar.–Apr. 1964 p 1–97
(FTD-MT-64-558; AD-670077)

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N68-33116# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

THE WEIGHT STRUCTURE OF DYADIC BICOMPACTS [O VESOVOM STROYENII DIADICHESKIKH BIKOMPAKTOV]

B. A. Yefimov *In its* Moscow Univ. Herald. Ser. 1: Math., Mech., no. 2, 1964 6 Jun. 1967 p 3–13 refs (See N68-33115 20-19)

Various weight characteristics of dyadic bicompacts, continuous images of the generalized Cantor discontinuum are discussed. Author

N68-33117# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

ON DIFFERENTIAL-DIFFERENCE SCHEMES OF THE SECOND ORDER OF ACCURACY FOR QUASILINEAR PROBLEMS OF THE PARABOLIC TYPE WITH DISCONTINUOUS ELEMENTS [O DIFFERENTSIAL'NO-RAZNOSTNYKH SKHEMAKH VTOROGO PORYADKA TOCHNOSTI DLYA KVAZILINEYNYKH ZADACH PARABOLICHESKOGO TIPA S RAZRYVNYMI ELEMENTA]

V. A. Morozov *In its* Moscow Univ. Herald. Ser. 1: Math., Mech., no. 2, 1964 6 Jun. 1967 p 15–26 refs (See N68-33115 20-19)

For a specific rectangle, a parabolic type equation is studied for initial and boundary conditions. For the particular boundary problems discussed, it is shown that there exist differential-difference schemes with second-order accuracy both in the case of smooth and discontinuous elements. Estimates of the error for the approximations obtained and the desired solutions are given. A method close to the energy method is used for the proof developed. Author

N68-33118# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

ON STRATIFIABLE CONGRUENCES OF THE AXES OF FOCAL CONGRUENCES [O RASSLOYAYEMYKH KONGRUENTSIYAKH OSEY FOKAL'NYKH KNOGRUENTSIY]

G. B. Khasin *In its* Moscow Univ. Herald. Ser. 1: Math., Mech., No. 2, 1964 6 Jun. 1967 p 27–35 (See N68-33115 20-19) refs

This paper treats the classification of nets whose congruences of the axes of the neighbouring Laplace transforms. Author

N68-33119# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

SEQUENTIAL AND CONTINUOUS LIMITS OF MEROMORPHIC AND PSEUDOMEROMORPHIC FUNCTIONS IN THE UNIT CIRCLE. 2 [PREDELY PO NEPRERYVNYM KRIVYM I PO POSLEDOVATEL'NOSTYAM TOCHEK NORMAL'NYKH MEROMORFNYKH I OBOBSHCHENNYKH MEROMORFNYKH V YEDINICHNOM KRUGE FUNKTSIY. 2]

V. I. Gavrilov *In its* Moscow Univ. Herald. Ser. 1: Math., Mech., No. 2, 1964 6 Jun. 1967 p 37–44 refs (See N68-33115 20-19)

The present paper contains some applications and generalisations of previous results obtained by the author. Author

N68-33122# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

ON THE PROCESS OF THE TRANSITION OF A FLEXIBLE SHAFT THROUGH CRITICAL SPEEDS WITH SMALL VISCOUS FRICTION [K PROTSESSU PEREKHODA GIBKOGO VALA CHEREZ KRITICHESKIYE SKOROSTI PRI MALOM VYAZKOM TRENII]

V. V. Kuramyshkin *In its* Moscow Univ. Herald. Ser. 1: Math., Mech., No. 2, 1964 6 Jun. 1967 p 59–61 (See N68-33115 20-19) refs

Approximate formulae are obtained to evaluate integrals encountered in the investigation of transition process. These integrals are plotted according to exact and approximate formulas. Author

N68-33126# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

ON THE ASYMPTOTIC THEORY OF RELAXATION OSCILLATIONS IN SYSTEMS WITH ONE DEGREE OF FREEDOM . . . [K ASIMPTOTICHESKOY TEORII RELAKSATSIONNYKH KOLEBANIY V SISTEMAKH S ODNOY STEPEN'YU SVOBODY]

S. S. Pul'kin and N. Kh. Rozov *In its* Moscow Univ. Herald. Ser. 1: Math., Mech., No. 2, 1964 6 Jun. 1967 p 83–97 refs (See N68-33115 20-19)

This study is closely related to known investigations on the general asymptotic theory of relaxation oscillations. The author deals with the system of second order $\epsilon\dot{x} = f(x,y)$; $\dot{y} = g(x,y)$, where ϵ is a small positive parameter. Let the functions f and g in (1) be sufficiently smooth, and the set $l' = \{x,y: f(x,y) = 0\}$ be a smooth curve in the x,y plane on which $(f_x')^2 + (f_y')^2 > 0$. The author studies solutions near those points at which the following two equalities are simultaneously satisfied: $f(x,y) = 0$, $f'_x(x,y) = 0$. A point S of the phase plane is called an irregular point of order m if $f'(S) = f'_x(S) = \ldots = f^{(m-1)}_x(S) = 0$; $f^{(m)}_x(S) \neq 0$; $f'_y(S) = 0$; $g(S) \neq 0$. A method is indicated for calculating (with any degree of accuracy) phase trajectories near an irregular point of order m. Author

N68-33245*# National Aeronautics and Space Administration, Washington, D. C.

NUMERICAL ANALYSIS—ABSTRACTS OF PRESENTATIONS

Raymond H. Wilson, Jr., ed. 1968 46 p refs Abstracts of papers presented at a workshop meeting on numerical analysis, held in Washington, D. C., 29–30 Jan. 1968

(NASA-SP-170) CFSTI: HC $3.00/MF $0.65 CSCL 12A

Abstracts are presented for the 34 papers given at a NASA workshop on numerical analysis applications to aerospace and related problems. Included are topics such as the integration of lunar motion, calculation of atmospheric properties, techniques for determining thermal radiation, nonlinear methods in aeroelasticity, and evaluation of the geopotential forces for an orbital ephemeris with given high-order harmonics. Other topics deal with heat transfer of a finned spacecraft cylinder, orbital lifetime predictions, optimization problems, and stress analysis. Papers also consider application of the convolution integral, series representations, Bairstow's method, potential theory, and error bounds for real roots. A Heuristic integration program is discussed as are Frechet and other derivatives in a Banach space, multidimensional integrals, truncation errors, biharmonic analysis, and use of the Householder algorithm for solving linear least squares problems. Nonlinear transformations, a boundary value problem solution, and certification of library subroutines are also treated. M.W.R.

N68-33255*# Delaware Univ., Newark.

AN ASCENT EXISTENCE AND UNIQUENESS PROOF FOR LINEAR ORDINARY DIFFERENTIAL EQUATIONS

E. J. Pellicciaro [1968] 10 p Presented at the Am. Mathematical Soc. 73d Summer Meeting, Madison, Wis., 26–30 Aug. 1968

(Grant NGR-08-001-016)

(NASA-CR-96365) CFSTI: HC $3.00/MF $0.65 CSCL 12A

A method of ascent proof is given which, starting with the solutions of the first order linear differential equation, describes inductively the solutions of the n-th order equation in terms of those of the n-1st order. The proof provides a representation formula which can be verified by direct substitution to be a solution indeed. Considered particularly interesting is the manner in which the solutions of the n-1st order equation appear in the formula, especially in connection with their role in the generation of linearly

independent solutions. A second form, a Volterra form, of the solution is included. Merit of the first is seen in its simplicity, in both derivation and form, and in its adaptability to verification. The method itself is a counterpart of the method of reduction of order.
Author

N68-33275# RAND Corp., Santa Monica, Calif.
ALLOCATING UNRELIABLE UNITS TO RANDOM DEMANDS
Allen Klinger and Thomas A. Brown Nov. 1967 64 p refs
(Contract F44620-67-C-0015)
(RM-5302-PR; AD-661540)

The results presented were obtained in a systems analysis study. Analytical expressions are presented for such quantities as the probability of successfully supplying a random number of demands (or customers) with successfully functioning units drawn from a fixed supply of items which fail at random. The mathematical properties of the several functions considered useful are investigated in some detail.
Author (TAB)

N68-33334# National Bureau of Standards, Washington, D. C.
MATRIX REPRESENTATIONS OF GROUPS
Morris Newman Jul. 1968 84 p refs *Its* Appl. Math. Ser. No. 60
GPO: HC $0.60; CFSTI: MF $0.65

The theory of group representations is presented from the matrix standpoint with objective of making available the results and techniques of the subject of group representations to an audience with at most a standard mathematical background. The entire development has arbitrarily been limited to the case when the ground field is the field of complex numbers. Many special representations are worked out in detail, and the elements of the theory of algebraic numbers are reviewed.
B.S.D.

N68-33364# Aerospace Corp., San Bernardino, Calif.
DETERMINATION OF COMPONENT STATISTICAL PARAMETERS TO MEET SYSTEM REQUIREMENTS
Frank C. Bond May 1968 25 p
(Contract F04695-67-C-0158)
(TR-0158-S3960-30-1; SAMSO-TR-68-252; AD-671981)

For a sum of independent random variables where all the components except one have known statistical parameters, the mean and variance of the unknown component are determined in accordance with a probabilistic constraint on the sum. The constraint is of the form: The probability that the sum will not exceed a specified value, w^*, must be at least P^*. In general, there is an acceptable range over which the unknown mean and variance may vary and still satisfy the constraint on the sum. The results of this paper may be utilized in defining acceptable statistical characteristics for a components weight in a system having the probability constraint above.
Author (TAB)

N68-33428*# Pennsylvania State Univ., University Park.
DIFFERENTIAL SYSTEMS
Robert Bradley McNeill Washington NASA Aug. 1968 61 p refs
(Grant NGR-39-009-041)
(NASA-CR-1164) CFSTI: HC $3.00/MF $0.65 CSCL 12A

An attempt is made to secure a comprehensive theory for linear and nonlinear differential systems under most general conditions. A generalized form of Bellman's fundamental lemma and the correct proof of Lagrange's variation of parameters formula is presented. Linear systems were studied with respect to the sets beta and zeta. Here an important necessary and sufficient theorem of Conti was generalized. Moreover, a stronger sufficiency theorem was shown, even though one of the original conditions was dropped. This allowed an obvious extension to the set zeta, which was unattainable via the original theorem. Nonlinear systems are studied by means of their accompanying integral equations. A converse theorem to a standard result is given. The concept of one vector being bounded with respect to another vector is introduced, and a series of theorems concerning this definition follows. Sharper upper bounds were derived. Finally, Lagrange's variation of parameters formula was extended to a certain class of nonlinear systems. Oscillation theorems are presented in order to strengthen previous derivations.
Author

N68-33463 California Inst. of Tech., Pasadena.
SPECTRAL DENSITY OF FIRST ORDER PIECEWISE LINEAR SYSTEMS EXCITED BY WHITE NOISE
John David Atkinson (Ph.D. Thesis) 1967 200 p
Available from Univ. Microfilms: HC $9.00/MF $3.00 Order No. 67-14343

The Fokker–Planck (FP) equation is used to develop a general method for finding the spectral density for a class of randomly excited first order systems. For such systems, it is shown how the Laplace-transformed FP equation can be solved for the transformed transition probability density. By manipulation of the FP equation and its adjoint, a formula is derived for the transformed autocorrelation function in terms of the transformed transition density. From this, the spectral density is readily obtained.
Dissert. Abstr.

N68-33480 California Univ., Los Angeles.
SOME RESULTS IN THE CLASSIFICATION THEORY OF RIEMANNIAN MANIFOLDS
Richard Emmanuel Katz (Ph.D. Thesis) 1967 55 p
Available from Univ. Microfilms: HC $3.00/MF $3.00 Order No. 67-14311

In this dissertation some of the results in the classification of Riemann surfaces are generalized to orientable Riemannian manifolds of arbitrary dimension. The major portion of the results are concerned with the type of a manifold (parabolic or hyperbolic) and tests for parabolicity. Let M be an orientable (noncompact) Riemannian manifold and A an annulus contained in M. The concepts of harmonic measure, modulus and extremal length of A are introduced and the equality of extremal length and modulus of A is proved. The last chapter relates the class of harmonic functions with finite Dirichlet integrals to the class of bounded harmonic functions with finite Dirichlet integrals. It is shown that the existence of a nonconstant element of the former implies the existence of a nonconstant element of the latter, or in the language of classification theory, that $O_{HD} = O_{HBD}$.
Dissert. Abstr.

N68-33608 National Lending Library for Science and Technology, Boston Spa (England).
CHARACTERS OF THE IRREDUCIBLE COMPLEX REPRESENTATIONS OF THE GROUP OF TRIANGULAR MATRICES ON A SIMPLE FINITE FIELD [PRO KHARAKTERI NEZVIDNIKH KOMPLEKSNIKH ZOBRAZHEN GRUPI TRIKUTNIKH MATRITS NAD PROSTIM SKINCHENNIM POLEM]
S. S. Polyak Feb. 1968 4 p refs Transl. into ENGLISH from Dopovidi Akad. Nauk Ur. RSR (Kiev), no. 4, 1966 p 434–436 (RTS-4268) Available from Natl. Lending Library, Boston Spa, Engl.: 7s 6d

Described is a theorem for determining the characters (integers) of the group G_n of triangular matrices over a simple finite field r on the basis of the assumption that G_n is a universal p group in the sense that any finite p group is a subgroup of some group of triangular matrices upon field r.
S.C.W.

N68-33609 National Lending Library for Science and Technology, Boston Spa (England).
IRREDUCIBLE COMPLEX REPRESENTATIONS OF THE GROUP OF TRIANGULAR MATRICES OVER A PRIME FINITE FIELD
S. S. Polyak Dec. 1967 8 p refs Transl. into ENGLISH from Dopovidi Akad. Nauk Uk. RSR (Kiev), 1966 p 13–16
(RTS-4266) Available from Natl. Lending Library, Boston Spa, Engl.: 7s 6d

Described are schemes for finding irreducible complex representations of a group of triangular matrices of order n over a prime finite field. S.C.W.

20 METEOROLOGY

Includes climatology; weather forecasting; and visibility studies. For related information see also: 13 Geophysics; and 30 Space Sciences.

N68-32282*# Allied Research Associates, Inc., Concord, Mass.
WORLD-WIDE CLOUD COVER DISTRIBUTION FOR USE IN COMPUTER SIMULATIONS Final Report, 18 Jan. 1967–17 Jan. 1968
Paul E. Sherr, Arnold H. Glasen, James C. Barnes, and James H. Willand Huntsville, Ala. Marshall Space Flight Center NASA 14 Jun. 1968 272 p refs
(Contract NAS8-21040)
(NASA-CR-61226) CFSTI: HC $3.00/MF $0.65 CSCL 04B

Probability distributions were prepared for use in the simulation of earth-oriented observations from space. Five cloud groups, including one for clear and one for overcast skies, are presented for 29 cloud climatological regions, for eight times of day and for each month of the year. In addition, conditional distributions were prepared to represent the temporal and spatial conditionality of the cloud cover 24 hours later or 200 nm away. These data are contained on 1740 punched cards. Marked changes in the cloud cover distributions corresponding to changes in the sampled area size are demonstrated. Techniques are presented to allow the ground observations to be transferred into distributions representing enlarged sample areas. Engineering and simulation applications of the cloud data bank are discussed. One example demonstrates a Monte Carlo approach for establishing the sighting probability of a given set of landmarks. The other example uses an analytical approach to determine probable cumulative area coverages for a photographic mission using N orbital passes. Author

N68-32293# McGill Univ., Montreal (Quebec). Stormy Weather Group.
MEASUREMENT OF SNOWFALL BY RADAR
Paul E. Carlson Mar. 1968 41 p refs
(Contract F19628-67-C-0129)
IMW-54; SR-5; AFCRL-68-0184; AD-671941)

Using wavelength 3.2 cm in dry snow, radar returns from a layer at an average height of 5000 ft were converted to snowfall rates and integrated to obtain isohyets for a 48-hour period, during which snow accumulated to an average depth of 5 inches. First, radar-derived isohyets based on the $Z = 2000\ R2.0$ relation for aggregate snow were mapped to 100-miles range. These were then compared with isohyets based on ground measurements of new-fallen snow at 140 climatological stations. Within 58-miles range, there was good agreement on maximum snowfall amounts (10 inches), most of which fell at high rates; but the radar underestimated the minimum amounts (2 inches), all of which fell at low rates. Agreement between radar and ground measurements was generally improved by applying a modified relation, $Z = 1000\ R2.67$. For this relation, the values of RADAR/CLIMAT ratio (radar-measured to ground-measured amounts) at grid points within 58-miles range had a near-Gaussian distribution, with a mean value of 0.98 and standard deviation of 0.29. Beyond 58-miles range, underestimation by the radar increased with range, particularly for the larger snowfall amounts. Comparison of radar-measured snowfall rates at a fixed point aloft with rates measured by a recording gauge at the ground showed good agreement after allowance was made for horizontal displacement of the snow during its fall. Author (TAB)

N68-32304# Army Electronics Command, Fort Monmouth, N. J.
SURFACE AND AIRBORNE CONDENSATION NUCLEI MEASUREMENTS IN REMOTE AREAS
Laurence J. Budney Mar. 1968 14 p
(ECOM-2954; AD-671598)

Condensation nuclei concentration measurements were made in the vicinity of Flagstaff, Arizona, during July 1966. The purpose of these measurements was to determine typical nuclei concentrations in the area and to correlate concentration with time of day, elevation, and weather conditions. The measurements were made both near the surface and from an aircraft. From the aircraft measurements it was found that condensation nuclei concentrations decreased with elevation. There was no apparent difference between concentrations in clear air, clouds, or rain. The ground-level measurements, about one foot above the surface, indicated concentration of about 1000 to 1500 particles per cubic centimeter during sunrise and continuing for several hours thereafter. Sharp peaks in concentration occurred during the mid-day hours on each of the three days of ground-level measurements. Author (TAB)

N68-32360 National Lending Library for Science and Technology, Boston Spa (England).
ON STATISTICAL RELATIONSHIPS BETWEEN THE OUTGOING RADIATION AND METEOROLOGICAL PARAMETERS OF THE ATMOSPHERE
L. R. Rakipova [1968] 24 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Fiz. Atmosfery i Okeana (Moscow), no. 3, 1967 p 845–858
(M-7132) Available from Natl. Lending Library, Boston Spa, Engl.

Correlations between the outgoing radiation of the earth atmosphere system and the general cloudiness, the temperature of the top of the cloud layer, the temperature of the underlying surface, the amount of water vapor in the atmosphere, etc. were analysed, using a wide range of statistical data. Some of the correlations were very strong. An estimate was made of the stability of the correlations discovered and of the degree to which they depend on the method determining the outgoing radiation. Author

N68-32428 National Lending Library for Science and Technology, Boston Spa (England).
PHYSICO-STATISTICAL METHODS OF FORECASTING WEATHER AND THE POSSIBILITY OF INTRODUCING THEM
M. J. Judin [1968] 20 p Transl. into ENGLISH from Meteorol. i Gidrol. (Moscow), no. 11, 1967 p 39–49
(M-7190) Available from Natl. Lending Library, Boston Spa, Engl.

The conditions which must be satisfied for the rational physico-statistical weather forecasting are examined and some methods of achieving them are indicated. A test of a statistical method of long range forecasting is described. A number of suggestions are advanced for the further development and introduction of such methods together with hydrodynamical-statistical methods of long range forecasting. Author

N68-32437 National Lending Library for Science and Technology, Boston Spa (England).
THE PACIFIC OCEAN STRATOSPHERIC ANTICYCLONE AND ITS ROLE IN THE THERMAL REGIME OF THE STRATOSPHERE OVER THE NORTH-EASTERN USSR IN WINTER
E. Ju Bezuglaja 1967 10 p refs Transl. into ENGLISH from T. Gl. Geofiz. Observ. (Leningrad), no. 211, 1967 p 17-22 In ENGLISH and RUSSIAN
(M-7367) Available from Natl. Lending Library, Boston Spa, Engl.

The position of the Pacific stratospheric anticyclone is considered. A chart of the frequency of the anticyclone in the winter months is drawn using daily charts of the 30 mb isobaric surface. The paths along which the stratospheric warm region moved during stratospheric warmings in 1963–1964 are determined. The annual variation of the temperature at heights of 20–25 km over the north-east of the USSR is shown. It is noted that the Pacific anticyclone has a great influence on the thermal regime of the stratosphere. Author

N68-32438 National Lending Library for Science and Technology, Boston Spa (England).
SOME PROBLEMS OF INTERPRETING PRECIPITATION GAUGE DATA
R. L. Kagan 1967 24 p refs Transl. into ENGLISH from Tr. Gl. Geofiz. Observ. (Leningrad), no. 208, 1967 p 64–75 In ENGLISH and RUSSIAN
(M-7369) Available from Natl. Lending Library, Boston Spa, Engl.

The accuracy is considered of data on the mean depth of precipitation on an area obtained from observations at a network of nonuniformly distributed precipitation gauge points. A method for finding optimal weights for each station, using the spatial correlation function for the precipitation field is proposed. The question of the possibility of reduction factors for the correlation functions using a transformation of the precipitation scale is also considered. Author

N68-32439 National Lending Library for Science and Technology, Boston Spa (England).
ON THE PROBLEM OF AVERAGING PRECIPITATION GAUGE DATA
A. I. Puliscuk 1967 20 p refs Transl. into ENGLISH from T. Gl. Geofiz. Observ. (Leningrad), no. 208, 1967 p 76–87 In ENGLISH and RUSSIAN
(M-7370) Available from Natl. Lending Library, Boston Spa, Engl.

The problem of the correlation between areal means of liquid precipitation totals in the Valdaj and Primor'e regions of the Soviet Union is considered. Examples of the calculation of optimal weights to determine a weighted mean are given. Author

N68-32445 National Lending Library for Science and Technology, Boston Spa (England).
BASIC FEATURES OF ZONAL CURRENTS IN THE ATMOSPHERE
I. G. Guterman [1968] 38 p refs Transl. into ENGLISH from Tr. Nauchn.-Issled. Inst. Aeroklim. (Moscow), no. 46, 1967 p 52–73
(M-7204) Available from Natl. Lending Library, Boston Spa, Engl.

The zonal circulation of the atmosphere of the Northern Hemisphere is considered, using data on the long term zonal components of the resultant wind. An analysis is made of fluctuations in the zonal flow in certain years along the latitude belt around 55°N and along the meridian 140°E. Author

N68-32469 National Lending Library for Science and Technology, Boston Spa (England).
ON THE "TROPICAL EXPERIMENT" PROJECT
E. M. Dobryaman 4 Jul. 1968 19 p refs Transl. into ENGLISH from Meterol. i Gidrol. (Moscow), no. 12, 1967 p 12–20
(M-541) Available from Natl. Lending Library, Boston Spa, Engl.

The paper gives a short description of the project of making special observations in tropical regions in order to study the special features of the atmospheric circulation in low latitudes. Some aspects of the theoretical investigations connected with the fulfilment of the program of observations and the project are discussed. Author

N68-32475 National Lending Library for Science and Technology, Boston Spa (England).
DISTRIBUTION OF THE ANOMALIES OF MEAN MONTHLY PRECIPITATION TOTALS IN CONNECTION WITH THE PROPERTIES OF THE BASIC FORMS OF ATMOSPHERIC CIRCULATION AND WITH THEIR LONG TERM TRANSFORMATIONS
I. A. Bauman and A. D. Kanaeva [1968] 18 p refs Transl. into ENGLISH from Tr. Gl. Geofiz. Observ. (Leningrad), no. 211, 1967 p 94–103
(M-7203) Available from Natl. Lending Library, Boston Spa, Engl.

The precipitation anomalies are presented for various parts of the Northern Hemisphere in relation to the basic W, C and E types of atmospheric circulation. The long period variations of these anomalies are examined, together with their association with changes of the W, C and E systems. Author

N68-32482 National Lending Library for Science and Technology, Boston Spa (England).
THE VARIABILITY OF AIR TEMPERATURE IN THE FREE ATMOSPHERE OVER THE NORTHERN HEMISPHERE AND FEATURES OF ITS DISTRIBUTION IN DIFFERENT PHYSICO-GEOGRAPHICAL REGIONS
I. V. Hanevstaja [1968] 93 p refs Transl. into ENGLISH from Tr. Nauchn.-Issled. Inst. Aeroklim. (Moscow), no. 46, 1967 p 74–128
(M-7346) Available from Natl. Lending Library, Boston Spa, Engl.

An investigation is made into the degree to which normal distribution law for random quantities is applicable to the actual temperature distribution in the free atmosphere. A statistical estimate is given of the stability of characteristics of the variability and asymmetry of temperature in the series of years considered. Charts of the standard deviation and charts of the asymmetry of the temperature distribution over the Northern Hemisphere are used to discover the layers and regions in which the temperature is most variable and the regions in which the thermal inhomogeneity of the atmosphere is best marked. It is shown that it is possible to calculate a probabilistic temperature distribution close to the actual one, using statistical parameters. This is important in the use of calculated data over territories with a sparse aerological network. Author

N68-32488* McGill Univ., Montreal (Quebec). Stormy Weather Group.
CONVECTIVE OVERTURNING AND SUMMER STORMS
J. Stewart Marshall Jan. 1968 31 p refs
(Contract F19628-67-C-0128)
(MW-50, SR-4; AFCRL-68-0183; AD-671940)

The outer shell of a cumulus cloud should be quite stable, and its pattern should be more clear-cut than a cloud of smoke, say, because it is the result of mixing cloud and unsaturated air. Toward the centre of the cloud there should be instability, moderated by mixing, and progressively-increasing liquid water content. The distance that a parcel of cloud can descend in the

unstable regime depends on the liquid water content. The possibility is considered that the rate at which the mass of air in a cloud increases approximately equals the rate of entrance through advancing sidewalls and top. This requires that inflow and outflow through the base be equal in mass of air, but that the latter be drier. This model of circulation simplifies the coupling of the cloud to the layer of air from cloud-base to ground. Author (TAB)

N68-32490# Air Force Cambridge Research Labs., Bedford, Mass. Aerospace Instrumentation Lab.
CLOUD DETECTION CAPABILITY OF OPERATIONAL AN/TPQ-11 RADAR SETS DURING 1966–1967
Arthur J. Kantor May 1968 15 p refs *Its* Instrumentation papers, No. 142
(AFCRL-68-0269; AD-671484)

Standard visual observations of cloud height have been compared with cloud data taken from the AN/TPQ-11 cloud detector, a vertically-pointing, fixed-beam radar set with a wavelength of 0.86 cm. Approximately six months of observations (1966 and 1967) were used at each of four USAF field stations (Yokota AB, Eglin AFB, Myrtle Beach AFB, and Scott AFB) between latitudes 30 degrees and 40 degrees N. Ability of these operational radars to detect clouds averaged 62 percent, which is considerably lower than the 85 percent value determined during development of the AN/TPQ-11 equipment. Consequently, current AN/TPQ-11 records appear to be severely limited as a means of reducing the bias now present in middle and high-cloud climatologies. It has been recommended that procedures be initiated to insure that operational AN/TPQ-11 cloud radars perform up to the capability indicated in earlier tests. Addendum A at the end of this report describes efforts to establish such procedures. Author (TAB)

N68-32546# Weather Bureau, Salt Lake City, Utah. Scientific Services Div.
SMALL-SCALE ANALYSIS AND PREDICTION
Philip Williams, Jr. May 1968 101 p refs
(WBTM-WR-29; PB-178425) CFSTI: HC $3.00/MF $0.65

The Weather bureau's small scale analysis and prediction program formally got under way with the issuance by Weather Bureau headquarters of a memo requesting local offices to shift their emphasis from broad scale features of the synoptic situation to small scale details. The purpose of the study is to give information on small scale weather guidance material plus newer developments in this area, and finally to present some outstanding small scale programs that have been developed by various Western Region meteorologists. Author (USGRDR)

N68-32564 National Lending Library for Science and Technology, Boston Spa (England).
ON THE ACCURACY OF DETERMINATION OF THE MEAN FIELD OF PRECIPITATION ON A SURFACE
M. V. Guscina, R. L. Kagan, and A. I. Poliscuk [1968] 24 p refs Transl. into ENGLISH from Tr. Gl. Geofiz. Observ. (Leningrad), no. 208, 1967 p 49–63
(M-7372) Available from Natl. Lending Library, Boston Spa, Engl.

The statistical structure of the liquid precipitation total is studied for various physico-geographical conditions. The data on the statistical structure are used to estimate the standard error in determining the mean depth of precipitation on an area from measurements made at specific points. Author

N68-32568# National Severe Storms Lab., Norman, Okla.
THUNDERSTORM-ENVIRONMENT INTERACTIONS BY CHAFF TRAJECTORIES IN THE MID-TROPOSPHERE
James C. Fankhauser Jun. 1968 21 p refs
(ERLTM-NSSL-39)

Some physical convective storm models suggest that large thunderstorms create effective barriers to the environmental airflow through the process of vertical momentum transport in their vigorous updrafts and downdrafts. Hydrodynamically, the relative air motion near a thunderstorm has been considered analogous to potential flow around a solid cylinder. Appraisals of thunderstorm water and energy budgets demonstrate, on the other hand, that potentially cold dry air must enter the storm circulation at some midcloud level aloft, in order to supply air with properties observed in the downdraft region beneath the storm. Both of these opposing conditions are supported by analysis of the trajectories of chaff deposited at midcloud level on the upwind and downwind sides of a mature thunderstorm. Circulations derived from the chaff motion are compared with independent wind measurements obtained from an airborne Doppler system and rawinsondes, and to flow characteristics demonstrated by classical hydrodynamical experiments. Author

N68-32583*# National Aeronautics and Space Administration, Marshall Space Flight Center, Huntsville, Ala.
WIND VECTOR CALCULATION USING CROSSED-BEAM DATA AND DETECTOR ARRANGEMENT FOR MEASURING HORIZONTAL WINDS
W. H. Heybey 11 Jul. 1968 50 p ref
(NASA-TM-X-53754) CFSTI: HC $3.00/MF $0.65 CSCL 04A

Three ground-based detectors suffice for determining wind vectors present in a certain space volume. While this is true in general, the geometry simplifies a great deal when these vectors can be taken as horizontal. The pertinent method for arrangement of detector positions and attitudes has been developed. With a suitable layout, winds reasonably constant near a selected height and blowing into and out of a quarter of the rose can be calculated with sufficient accuracy and confidence. The error analysis assumes that the observational time uncertainty is at most ±0.1 sec. To observe wind vectors in the remaining directions or at several heights simultaneously, the use of more detectors or multiple detectors is called for. Author

N68-32600 National Lending Library for Science and Technology, Boston Spa (England).
AREAS OF LARGE ANOMALIES OF MEAN MONTHLY AIR TEMPERATURE FROM THE LONG PERIOD AVERAGES IN THE NORTHERN HEMISPHERE
A. D. Gedeonov [1968] 12 p refs Transl. into ENGLISH from Tr. Gl. Geofiz. Observ. (Leningrad), no. 211, 1967 p 68–74
(M-7368) Available from Natl. Lending Library, Boston Spa, Engl.

The results of an investigation of areas of large anomalies in the monthly mean air temperature in the northern hemisphere in the period 1881–1960 are presented. Deviations of ± 10°C from the long-term mean were observed in a relatively small part of the northern hemisphere, mainly over land, while positive deviations were, on the whole, situated further north than negative ones. Regions are discovered in which large deviations of the monthly mean air temperature are formed; the deviations are grouped in definite, comparatively limited regions, not scattered over the whole territory subject to large deviations. Extreme values of the deviations are given, and possible ranges of fluctuations occurring in the period of time studied. Author

N68-32617 National Lending Library for Science and Technology, Boston Spa (England).
ATLAS OF CLIMATOLOGICAL PRESSURE-FIELD CHARACTERISTICS OF THE NORTHERN HEMISPHERE TROPOSPHERE
L. G. Zatsvenko [1967] 15 p refs Transl. into ENGLISH from Issled. Inst. Aeroklim. (Moscow), 1967
(M-7200) Available from Natl. Lending Library, Boston Spa, Engl.

Descriptive material related to an atlas of climatological pressure field charts in the northern hemisphere troposphere is presented, and some data are included as to how the information for the charts was derived. Charts of the mass of air in layers of the troposphere and changes between January and July are discussed; as are charts of the zonal and meridional components of the geostrophic wind, monthly mean contours of the 1000 mb isobaric surface, and mean contours of the annual range of the geopotential heights of the isobaric surfaces from 1000 to 100 mb. The atlas is not included in this document. M.W.F.

N68-32671 National Lending Library for Science and Technology, Boston Spa (England).
THE INTERACTION BETWEEN MACROSYNOPTIC PROCESSES IN THE TROPOSPHERE AND STRATOSPHERE OF THE NORTHERN HEMISPHERE. THE FUNCTION OF THE UNDERLYING SURFACE IN FORMING ANOMALIES IN THE CIRCULATION OF THE ATMOSPHERE
H. H. Rafailova, E. A. Cistjakova, and V. G. Semenov [1968] 113 p refs Transl. into ENGLISH from the book "Fluctuations in the General Circulation of the Atmosphere and Long Range Weather Forecasts" Leningrad, Izd. Gidrometeorol., 1967 p 152–228
(M-7201) Available from Natl. Lending Library, Boston Spa, Engl.

Composite-kinematic charts of stratospheric and tropospheric vortices were used to characterize several features of the successive development of types of macrocirculation and to demonstrate the feasibility of the assumption that it is possible to use data on stratospheric circulation regularities to compile long range weather forecasts, to establish the boundaries of natural synoptic seasons, and to discover the special features of their development. Included are detailed discussions of the main features of large scale modifications in the stratosphere during winter warmings in the Arctic and in the transitional time of year, and the development of the polar cyclonic vortex and the nature of spring in Eastern Siberia and the Far East. S.C.W.

N68-32716# Travelers Research Center, Inc., Hartford, Conn.
EVALUATION OF THE ATLANTIC CITY MESONET FOR SHORT RANGE PREDICTION OF AVIATION TERMINAL WEATHER Final Report
H. D. Entrekin, J. W. Wilson, and K. D. Hage Aug. 1968 126 p refs
(Contract FA-66-WA-1536)
(SRDS-68-40)

Mesoscale weather data collected from the meso-meteorological network (mesonet) were used for the development and testing of techniques for 15-, 30-, and 60-min predictions of runway visual range, cloud-base height, and wind. The primary purpose of this work was to evaluate the utility of the mesonet for improved prediction of aviation terminal weather. Studies included: analyses of the variability of fog, low-cloud and wind; preliminary development and testing of a prediction model based on advection; and, using detailed data analyses and a numerical-physical boundary-layer model, studies of methods for predicting changes due to nonadvective processes. The forecasts based on mesonet data were prepared by a simple advection model which used low-level winds. The results showed in general that some of the techniques which used mesonet data provided forecasts significantly better than those provided by persistence. It is therefore concluded that the mesoscale data provided from the Atlantic City mesonet are not adequate for providing significantly improved short-range terminal weather forecasts. Author

N68-32724# Weather Squadron (32nd), Tyndall AFB, Fla. Detachment 5.
FORECASTING SUMMER THUNDERSTORMS AT TYNDALL AFB, FLORIDA
Harry L. Edwards Aug. 1967 25 p
(AD-671984)

This climatological study summarizes several characteristics of thunderstorms at Tyndall AFB, Florida, based on six years of local observations. The climatological summaries in this paper are portrayed in a manner to facilitate their use as an aid in the daily forecast routine. Author (TAB)

N68-32725# Environmental Technical Applications Center (Air Force), Washington, D. C.
U. S. NAVAL WEATHER SERVICE WORLD-WIDE AIRFIELD SUMMARIES. VOLUME 6: CENTRAL AMERICA
Feb. 1968 379 p refs
(AD-671845)

The volume is part of a series of compilations which is world-wide in scope. It consists of climatological summaries for selected airfields and for the climatic areas in which they are located. When complete, the series will include data for approximately 3000 stations. This volume provides climatological summaries for airfields and climatic areas in Central America. TAB

N68-32729# California Univ., Davis. Dept. of Water Science and Engineering.
ENERGY, MOMENTUM AND MASS TRANSFERS ABOVE VEGETATIVE SURFACES Final Report
W. O. Pruitt, D. L. Morgan, and F. J. Lourence Ft. Huachuca, Ariz. Army Electron. Command May 1968 59 p refs
(Contract DA-02-086-AMC-0447(E))
(ECOM-0447(E)-F; AD-670051)

The report describes meteorological conditions and outlines the type of data collected during two major cooperative micrometeorological field studies which were conducted at Davis, California during 1967. The first study conducted in the Spring was under the direction and sponsorship of the Atmospheric Sciences Laboratory, Ft. Huachuca, Arizona. Participating were research groups from several universities and government agencies. Fall studies involved cooperative efforts of the University and a research group from the Naval Undersea Warfare Center, San Diego, California. Reported in detail are the various radiation data gathered during the Spring study. Good agreement between measured and summations of individual components for both shortwave and longwave radiation was found. The overall radiation balance, both total incoming and net radiation, was in relatively good agreement with direct measurements made by total and net radiometers. Surface albedo appeared to vary significantly, both with solar angle and with the quality of light being received. The effect of various climatic factors on the partition of net radiation is discussed. A combination energy balance - aerodynamic approach is used to illustrate the relative importance of temperature, humidity, wind speed and the level of (R sub n + G) itself on the partition of energy at a vegetative surface. Author (TAB)

N68-32738# Pennsylvania State Univ., University Park. Dept. of Meteorology.
SATELLITE RADIATION MEASUREMENTS AND SYNOPTIC DATA Interim Report, 1 Nov. 1966–31 Dec. 1967
H. A. Panofsky, Mee D. Lethbridge, J. Allen Zak, and Chin-hua Huang Mar. 1968 35 p refs
(Grant CWB-WBG-48)
(IR-3; PB-178402) CFSTI: HC $3.00/MF $0.65

A study of the diurnal variations of infrared radiation data at 8–12 microns was undertaken for a tropical, oceanic area. The area selected was over the western Pacific, one free of large land masses, bounded by the equator to the south, the 20th parallel to the north, 180 degrees longitude to the east and 130 degrees E longitude to the west. Author (USGRDR)

N68-32739# Florida State Univ., Tallahassee. Dept. of Meteorology.
SATELLITE STUDY, TROPICAL NORTH ATLANTIC, 1963. PART 2: SATELLITE AND CONVENTIONAL DATA. A DAILY COMPARISON
C. I. Aspliden, G. A. Dean, and H. Landers Dec. 1967 305 p refs
(Grant CWB-WBG-58)
(Rept.-67-11; PB-178434) CFSTI: HC$3.00/MF$0.65

The document presents twenty-four hour continuity at sea level and at 200 mb plus cloud charts and mosaic presentation of satellite pictures of a large part of the Atlantic Ocean. Author (USGRDR)

N68-32753# Emmanuel Coll., Boston, Mass. Oriental Science Library.
ON THE ESTIMATION OF EVAPORATION FROM A LAND SURFACE
Chen-Hsing Liu May 1968 14 p refs
(Contract AF 19(628)-5073)
(EMM-67-169; AD-671351)

Evaporation from a land surface is a complicated process and the problem of estimating this factor has not been adequately solved up to the present. It is generally known that when underground exchange of water is absent, the equation for the mean water balance over a period of years assumes a simple form where X is the amount of precipitation, Y the runoff and Z the evaporation. Evaporation is known to be correlated with runoff or precipitation and numerous empirical formulas for the various basins have been derived in the past from a large amount of observational data. Among the best known ones are the Ol'dekop formula. Author (TAB)

N68-32756# Chicago Univ., Ill. Dept. of the Geophysical Sciences.
A PROCEDURE FOR OPERATIONAL PREDICTION OF WIND SET-UP ON LAKE ERIE
George W. Platzman Nov. 1967 89 p refs
(Contract E-91-67(N))
(TR-11; PB-178336) CFSTI: HC$3.00/MF$0.65

The report contains a proposal for operational prediction of wind set-up on Lake Erie. The input data are observed and forecast winds coded in the format of the Great Lakes Marine Forecasts issued by the Chicago Forecast Center of the Weather Bureau. These are applied to a set of pre-computed response tables from which, by superposition, a forecast is obtained of consecutive three-hourly lake levels (relative to the prevailing mean lake level) at particular locations for a 24-hour period. The response tables are constructed by numerical integration of a linear hydrodynamical 'channel' model. A detailed description of the proposed forecast procedure is given in this report, and all necessary tables and forms are included. The procedure is manual, involves only simple additions and subtractions, and can be carried out normally in less than ten minutes. Author (USGRDR)

N68-32757# Michigan Univ., Ann Arbor. Dept. of Meteorology and Oceanography.
SATELLITE OBSERVATIONS RELATED TO ATMOSPHERIC PLANETARY WAVE DYNAMICS
James H. S. Bradley and Aksel C. Wiin-Nielsen Feb. 1968 71 p refs
(Contract CWB-11377)
(Rept.-08203-2-T; PB-178499) CFSTI: HC$3.00/MF$0.65

Satellite observations of cloud cover and brightness are used to show that the Northern and Southern Hemispheres and the tropics are coupled, at least strongly enough to cause substantial correlations between systems close together in free period. Large exchanges of matter, momentum and energy are not necessarily implied. Modes confined to the tropics, and uncoupled middle latitude modes, account for 10% to 20% of the variance in their respective areas. At least one physical mechanism remains undiagnosed, which may be the vertical structure (H_2, L_1 mode). An unpredicted conclusion is that the large scale cloudiness moves with approximately the Rossby–Haurwitz velocity of the first vertical (H_1) mode of the second meridional (L_2) mode of the geopotential. Zonal harmonics show definite advantages over other representations of the east-west structure. Methodological improvements are presented in the representation of three dimensional characteristic patterns, in the estimation of uncoupled modes from variance explained, and in the numerical analysis of eigenvalues and eigenvectors of symmetric matrices. A notation for vertical and horizontal modes is introduced. Author (USGRDR)

N68-32771 National Lending Library for Science and Technology, Boston Spa (England).
THE DETERMINATION OF VISIBILITY FROM HIGH INTENSITY LIGHTS
S. M. Alexsanjanc, Ju. G. Konovalov, and V. I. Unukov [1968] 13 p refs Transl. into ENGLISH from Meteorol. i Gidrol. (Moscow), no. 8, 1967 p 76–81 In RUSSIAN and ENGLISH
(M-7176) Available from Natl. Lending Library, Boston Spa, Engl.

Consideration is given to the use of high intensity lighting (HIL) for lowering the weather minima established for safe landing at a given airport. Attention is focused on devising a method of finding the visual range of HIL. Equations are given along with the initial data for determining the visual range. These data are the meteorological visibility found in accordance with some threshold contrast sensitivity of the eye representative of the light intensity and light sensitivity threshold of the eye which depends on the brightness of the background. A relationship is drawn between the threshold of light sensitivity of the eye and brightness of the background, and the use of a recording transistometer for measuring meteorological visibility is discussed. A computer system which uses the principle of automatic closed-loop controls is also briefly mentioned for computing visual range of the HIL. B.S.D.

N68-32772# New Mexico Univ., Albuquerque. Bureau of Engineering Research.
A STUDY OF INTERPOLATION AND SMOOTHING OPERATIONS IN OBJECTIVE ANALYSIS Final Report
Daniel P. Petersen 15 Dec. 1967 143 p refs
(Contract DC-7-35028)
(EE-148; PB-178482) CFSTI: HC$3.00/MF$0.65

The objective analysis algorithm, currently used for interpolation of synoptic upper air observations to a square grid for numerical predictions, is examined from the viewpoint of its two-dimensional wave-number transfer characteristics. Applications of the results obtained to the design of observation networks and to the planning and evaluation of numerical experiments in weather data processing are discussed. Author (USGRDR)

N68-32777 National Lending Library for Science and Technology, Boston Spa (England).
FORECASTING AIR TEMPERATURE AT THE EARTH'S SURFACE
O. P. Glazova 2 Jul. 1968 7 p refs Transl. into ENGLISH from Meteorol. i Gidrol. (Moscow), no. 4, 1968 p 22–30 In ENGLISH and RUSSIAN
(M-543) Available from Natl. Lending Library, Boston Spa, Engl.

The sequence is discussed, in which the factors determining the air temperature in the surface boundary layer should be considered. A sample forecast of the minimum and maximum air temperatures at the surface in the cold part of the year is given. At present techniques are available which permit the calculation

of those main factors (advection, modification, diurnal variation) which determine the air temperature in the surface boundary layer. But there are no indications in the literature of the sequence in which these factors should be considered in the preparation of a forecast of the air temperature near the earth's surface at different times in the future. Author

N68-32783# Emmanuel Coll., Boston, Mass. Oriental Science Library.
STUDIES ON THE MICROPHYSICAL MECHANISM OF PRECIPITATION FROM WARM CLOUDS
Xu-Ji Zhou May 1968 162 p refs
(Contract AF 19(628)-5073)
(EMM-66-128; AD-671350)

The characteristics of the growth of cloud drops as a stochastic process is described in the first chapter which is followed by a discussion of the theories of cloud-drop growth. The influence of fluctuations in fields of humidity, cloud-drop concentration, turbulence, and vertical motions and the effect of electric charge on growth by coalescence are considered in order to formulate a general statistical theory to account for precipitation from warm clouds. Author (TAB)

N68-32820# Air Force Cambridge Research Labs., Bedford, Mass.
AN ANALYSIS OF THE PERFORMANCE OF THE THREE-STATION SPARSA NETWORK FOR DETECTING AND TRACKING THUNDERSTORM ACTIVITY
Bernard O. Weiss May 68 233 p *Its* Instr. Papers No. 143
(AFCRL-68-0272; AD-671934)

The report presents an operational evaluation of the fully configured, three-station SPARSA network at Cape Kennedy Air Force Station. The purpose of the evaluation was to determine the networks ability to detect and track thunderstorms and to show the growth and decay of active cells in the triangulation area depicted on the display console. The data were collected over a period of 37 days in the summer of 1967 and include a total of 79 thunderstorms. The tests indicate that when manned continuously the SPARSA equipment successfully identified all known areas of electrical activity and in most cases provided ample warnings of storm growth and decay within a 50-mile radius of the Cape Kennedy Control Center. Surface weather observations in and around the triangulation area were used to verify SPARSA information. Author (TAB)

N68-32923# National Environmental Satellite Center, Washington, D. C.
THE NATURE OF INTERMEDIATE-SCALE CLOUD SPIRALS
Linwood F. Whitney, Jr. and Leroy D. Herman May 1968 80 p refs
(NESC-45)

The purpose of this investigation was to learn the nature of the so-called "secondary" cloud spiral and associated cloud enhancement that is viewed by satellites. Eight case sequences of two or three days each were compared with their mid-tropospheric vorticity fields and each of the various forcing function fields contributing to vorticity production at sea level. In the situations studied, it was found that the cloud spirals could be related to mid-tropospheric vorticity maxima associated with short-wave systems moving through the larger scale patterns. Thermal advection (namely, the Laplacian of thickness advection in the 1000-mb to 500-mb layer) was at least as significant as the mid-tropospheric (500-mb) vorticity advection in areas of cloud enhancement. It is important to note that the contribution of the thermal term may be either positive or negative, so that sometimes it serves to diminish and at other times to augment the effects of vorticity advection. Generally speaking, as the cloud system develops or becomes better organized, its effects become more positive. Author

N68-32941# Melbourne Univ., Parkville (Australia). Dept. of Meteorology
AN ANALYSIS OF SOME OBSERVATIONS OF VERTICAL AIR VELOCITY COMPONENTS MADE FROM AN AIRCRAFT
R. J. Taylor (Commonwealth Sci. and Ind. Res. Organ., Aspendale, Australia), J. Warner (Commonwealth Sci. and Ind. Res. Organ., Epping, Australia), and N. E. Bacon Apr. 1968 104 p refs
(Publ.-10) CFSTI: HC $3.00/MF $0.65

Observations of vertical air velocity components ranging from 23 to 273 seconds in duration and from 10 to 1310 m in height have been examined and frequency distributions and spectra have been calculated. These observations were accompanied by aircraft soundings of temperature and a number of types of ground-based observations. The results indicate that the frequency distribution of gust velocities is markedly different from normal. In stable conditions, the root mean square vertical velocity component (σ_w) decreases with increasing stability and more markedly so at the greater heights while no dependence on height itself can be demonstrated. In unstable conditions σ_w increases with increasing height (within the limited height range available) and decreases with increasing (absolute) temperature gradient. It is suggested that this last result is due to the effects of wind shear. "Derived gust velocities" calculated from the aircraft vertical acceleration alone overestimate the true gust velocity when this is small and underestimated when it is large. Author

N68-32970 National Lending Library for Science and Technology, Boston Spa (England).
SOME CHARACTERISTICS OF THE VARIABILITY OF HEIGHT OF CLOUD BASE
M. V. Rubinstejn [1968] 37 p refs Transl. into ENGLISH from Tr. Gidromet. Nauchn.-Issled. Cent. SSSR (Leningrad), no. 13, 1967 p 42–59
(M-7188) Available from Natl. Lending Library, Boston Spa, Engl.

On the basis of the processing and analysis of the results of specially organized observations at various points in the Soviet Union, a series of characteristics on the space-time variability of the cloud base (CB) is obtained as are their relationships to the time interval, the mean height of clouds, the geographical position of the observation point, the type of cloud and the distance between the points at which the height was measured. Probabilities for the variability of various heights of CB in various conditions are obtained. The relationships between the mean absolute magnitude of the variability of the height of CB and the probability of a change in height by a value greater than a given one is shown. The ratios of the probabilities that two or three airports at distances of up to 50 km from each other are simultaneously closed by cloud below 100 m or fog are obtained. Author

N68-32971 National Lending Library for Science and Technology, Boston Spa (England).
ORGANISING THE ENTERING OF SATELLITE INFORMATION ONTO BLANK GEOGRAPHICAL CHARTS
V. G. Kontantinova and I. A. Catverikov [1968] 12 p refs Transl. into ENGLISH from Tr. Gidromet. Nauchn.-Issled. Cent. SSSR (Leningrad), no. 11, 1967 p 169–174
(M-7111) Available from Natl. Lending Library, Boston Spa, Engl.

A numerical process for entering satellite data on blank geographical charts is described. The system which is based on the use of measurements coverted to rectangular coordinates on a map of stereographic projection is applicable to an electronic computer equipped with a device for printing letters and numbers. Initial data for the entering system are in the form of a numerical value of meteorological element and its corresponding geographical coordinates. The simplest variant of this system is the use of blank charts with a stereographic projection for the territory of the whole earth. B.S.D.

N68-33013# Emmanuel Coll., Boston, Mass. Oriental Science Library.
A PRELIMINARY STUDY OF THE GENERAL CIRCULATION IN THE UPPER TROPOSPHERE AND THE LOWER AND MIDDLE STRATOSPHERE OVER EAST ASIA
Shih-yen Dao, Yo-Fang Li, and Yu-Pu Wen Bedford, Mass. AFCRL May 1968 25 p refs Transl. into ENGLISH from Ch'i Hsiang Hsueh Pao (Peking), v. 35, no. 2, May 1965 p 155–165
(Contract AF 19(628)-5073)
(EMM-66-142; AD-671349)

A preliminary analysis of the characteristics of the general circulation in the upper troposphere and the lower and middle stratosphere over East Asia based on aerological data from more than 90 stations for the years 1957–1961 is presented. Author (TAB)

N68-33032# Chicago Univ., Ill.
A STUDY OF MESOSCALE CLOUD MOTIONS COMPUTED FROM ATS-1 AND TERRESTRIAL PHOTOGRAPHS
Tetsuya Fujita, Dorothy L. Bradbury, Clifford Murino, and Louis Hull Mar. 1968 30 p refs
(Grants CwB-WBG-34; NSF GA-864)
(SMRP-RP-71; PB-178403) CFSTI: HC $3.00/MF $0.65

A local area near Hawaii was selected for computation because a stereo-camera network was operated on top of Haleakala on Maui. Independent computation of cloud velocities from terrestrial photogrammetry revealed that the velocities of middle clouds computed from both ATS-I and terrestrial photographs are very close to each other. These cloud velocities were found to represent approximately the wind velocities at the cloud levels. An attempt was made to improve local upper-air analyses by adding the cloud velocities on corresponding upper-air charts even though the heights of the clouds were not known accurately. Also computed were the divergence and vorticity of the cloud velocities determined from ATS-I pictures. Despite the fact that it is uncertain that a group of clouds which moves with similar velocities is located at unique height, the computed fields are found to be quite meaningful. Author (USGRDR)

N68-33036*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
TEMPERATURE, PRESSURE, DENSITY, AND WIND MEASUREMENTS IN THE STRATOSPHERE AND MESOSPHERE, 1966
W. S. Smith, J. S. Theon, P. C. Swartz, L. B. Katchen, and J. J. Horvath (Mich. Univ., Ann Arbor) Washington Aug. 1968 94 p refs
(NASA-TR-R-288) CFSTI: HC $3.00/MF $0.65 CSCL 04B

Complete data are presented from a total of 43 rocket-borne experiments conducted at Wallops Island, Virginia; Churchill, Canada; Barrow, Alaska; Natal, Brazil; and Ascension Island in the South Atlantic Ocean during 1966. Temperature, pressure, density, and wind profiles from 39 grenade experiments, and temperature, pressure, and density profiles from four pitot static tube experiments covering the altitude range of approximately 30 to 90 kilometers have been compiled. No attempt has been made to analyze the meteorological significance of these data in this report. Error analyses are included for the results of each of the 39 grenade experiments. Author

N68-33069# Weather Squadron (24th), Kelly AFB, Tex. Detachment 5.
FORECASTING "GULF STRATUS" AT KELLY AFB, TEXAS
Paul R. Balcom Feb. 1968 9 p
(AD-671983)

The forecast study is an update and revision of an older report that was completed in Sep 1959. The inclusion of new tables to replace the monographs of the original study. Author (TAB)

N68-33231# McGill Univ., Montreal (Quebec). Stormy Weather Group.
A PRELIMINARY MICROWAVE ATTENUATION CLIMATOLOGY FOR THE MONTREAL AREA BASED ON WEATHER RADAR DATA
R. R. Rogers and K. M. Rao Jan. 1968 45 p refs Sponsored in part by Can. Defence Res. Telecommun. Estab.
(Contract F19628-67-C-0129)
(MW-52; AFCRL-68-0165; SR-3; AD-671538)

Radar records of thunderstorms for a five-month period including the summer of 1963 were analyzed statistically to determine frequencies of occurrence of high attenuations over propagation paths in various directions. Results are given in graphs of the number of hours per season that certain attenuations are exceeded for 100-mi horizontal propagation paths and for radio frequencies ranging between 5.5 and 45 GHz. On the assumption that storm structure is uniform up to a height of 5 mi, above which no attenuation occurs, the results are expressed for slant paths with elevations up to 20 degrees. It was found that the statistics for the high attenuations considered (10 db and greater at 10 GHz) are essentially determined by rainfall rates of 25 mm/hr and greater, and are rather insensitive to the assumed form of the relationship between rainfall rate and attentuation. A significant dependence on the bearing of the propagation path is evident. An assumption about the translation velocity of storms enabled the computation of the expected number of severe attenuation occurrences in a summer season. Author (TAB)

N68-33256 Freie Univ., Berlin (West Germany). Inst. fur Meteorologie und Geophysik.
SYNOPTIC-STATISTICAL INVESTIGATION OF THE HEAVY RAIN SITUATION IN MIDDLE EUROPE [SYNOPTISCH-STATISCHE UNTERSUCHUNGEN ZU STARKREGEN-WETTERLAGEN IN MITTELEUROPA]
Werner Wehry 1968 96 p refs In GERMAN; ENGLISH summary
CFSTI: $3.00

As defined in this paper, "heavy rain" is a situation in which more than 50 mm falls within 24 hours over an area of at least 50 km^2. Studies were 292 such cases that occurred in central Europe (Germany, Czechoslovakia, Poland) during the period 1950 through 1961. Except for seven cases (2%), these cases are arranged in five categories according to their weather situation: (1) Van Bebber-type lows; (2) wind damming up against mountains; (3) persistent stationary fronts, including cyclonic westdrifts; (4) thunderstorms in easterly flow; and (5) upper lows, without fronts in the area under consideration. Mean charts and deviations from the normal distribution are given for each type. Surface pressures and atmospheric temperature distribution are derived, and a system of coincidences is constructed for each rain type which shows the developing weather situation one day in advance. K.W.

N68-33311# Air Weather Service, Scott AFB, Ill.
ESTIMATING CONDITIONAL PROBABILITY AND PERSISTENCE
John T. McCabe Jun. 1968 23 p refs
(AWS-TR-208; AD-671506)

The report describes a statistical model and automated techniques which provide estimates of conditional and persistence probability of meteorological events for periods to 48 and 24 hours, respectively. The products are designed to assist forecasters and planners in instances where conditional and persistence

frequencies are not obtainable by directly processing observational data. The model considers the diurnal variability of the event by assuming joint probability according to elliptical distributions defined by known (or estimated) hourly unconditional probabilities and lag correlation coefficients obtained from previously summarized data. A computer program performs the integrations by transforming the elliptical distributions to the circular normal with rotated axes, and then counting the number of mil-frequency units in each of the joint probability zones. Comparison of conditional and persistence probability estimates of categorized cloud cover and ceiling/visibility events with observed frequencies of occurrence reveal root-mean-square differences of the order of 5% to 15%.
Author (TAB)

N68-33455*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
INTERPRETATION OF RADIATION DATA FROM METEOROLOGICAL SATELLITES
W. Nordberg Aug. 1968 36 p refs Presented at WMO Regional Training Seminar on Interpretation of Meteorol. Satellite Data
(NASA-TM-X-63314; X-620-68-312) CFSTI: HC $3.00/MF $0.65
CSCL 04B

Consideration is given to the important meteorological parameter of determining the balance between total emitted telluric and backscattered solar radiation. Various analytical models which are being developed to relate more rigorously the derived atmosphere parameters to the measured radiation quantities are discussed along with the development of instruments with higher spectral resolutions over a wide range of the solar and telluric spectrum. Among the instruments discussed are sensors for mapping of radiation patterns, and radiation sensors for sounding of the atmosphere. Techniques for analysis of cloud patterns observed in infrarred emission are examined and measurements of the net balance between incoming solar energy flux and outgoing longwave radiation at the top of the atmosphere derived from satellite observations are evaluated. Attention is also focused on observation of patterns of blackbody radiances measured in the window portions of emitted longwave radiation. These can provide for the mapping of significant features of temperature patterns, surfaces of land masses and oceans, and measurements of ocean temperatures.
B.S.D.

N68-33474 National Lending Library for Science and Technology, Boston Spa (England).
THE SYSTEM OF SATELLITES IN THE METEOROLOGICAL SERVICE
[1968] 17 p Transl. into ENGLISH from Meteorol. i Gidrol. (Moscow), no. 9, 1967 p 3–11
(M-7121) Available from Natl. Lending Library, Boston Spa, Engl.

A journalistic review of the Soviet weather service system is presented, emphasizing the present and future role of satellite observations. It is pointed out that satellite measurements of atmospheric pressure over all areas of the world are essential to a comprehensive study of air currents and for long range weather forecasting. The development of special electric equipment for these measurements is outlined. The instrumentation aboard Cosmos 144 and Cosmos 156 is also briefly described, along with the meteorological satellite system they form.
N.E.N.

N68-33518 National Lending Library for Science and Technology, Boston Spa (England).
CYCLIC CHANGES OF INTENSITY OF ZONAL CIRCULATION IN THE MIDDLE TROPOSPHERE AND THEIR TIME VARIATION
E. V. Vorob'eva [1968] 23 p refs Transl. into ENGLISH from Tr. Gl. Geofiz. Observ. (Leningrad), no. 211, 1967 p 56–67
(M-7366) Available from Natl. Lending Library, Boston Spa, Engl.

A study of zonal circulation intensity variations at the 500 mb level over the Northern Hemisphere is presented. A method for finding the periods of nonharmonic periodic functions was used. Intensity variations were found for all months of the year, and cycles in the variations were obtained at 2.43, 3.91, and 7.70 years.
C.T.C.

N68-33520 National Lending Library for Science and Technology, Boston Spa (England).
SOME RESULTS OF INVESTIGATIONS OF THE STATISTICAL CHARACTERISTICS OF THE WIND FIELD
M. O. Kricak [1968] 16 p refs Transl. into ENGLISH from Tr. Gl. Geofiz. Observ. (Leningrad), no. 208, 1967 p 32–40
(M-7373) Available from Natl. Lending Library, Boston Spa, Engl.

Results are presented of correlation function calculations for the wind field at the 500 mb level. The initial data were wind speeds and directions from 60 stations and 60 observation times during two summer and two winter seasons. The data were taken at three day intervals so that the samples could be considered statistically independent. The various assumptions and formulation methods of the calculations are presented, along with charts of the fields obtained from the calculations.
C.T.C.

N68-33552# Bureau of Meteorology, Melbourne (Australia).
TROPICAL CYCLONES IN THE NORTHERN AUSTRALIAN REGIONS 1965–66 SEASON
May 1968 63 p
CFSTI: HC $3.00/MF $0.65

Summary data are given on the various cyclones which occurred in the northern regions of Darwin, Brisbane, and Perth. The tropical disturbances are classified as: (1) Major tropical cyclones associated with winds exceeding 33 knots and extending more than 100 miles from the center; (2) Tropical cyclones associated with winds exceeding 33 knots but not extending more than 100 miles from the center; and (3) Minor tropical disturbances associated with wind speeds not exceeding 33 knots. Diagrams showing the tracks of the storms and central pressures are given. Case histories of each cyclone are discussed in relation to development, features of the track, rainfall, flooding and flood damage, winds and wind damage, sea, swell, storm surges, and related damage.
B.S.D.

N68-33583# Litton Systems, Inc., Monterey, Calif. Mellonics Systems Development Div.
EXTRACTING DIGITAL HISTORICAL WEATHER FIELDS FROM U. S. FLEET NUMERICAL WEATHER FACILITIES FILES Final Report
N. M. Stevenson and W. C. Woodworth Mar. 1968 31 p refs
(Contract E-166-67(N))
(PB-178360) CFSTI: HC $3.00/MF $0.65

The extraction of desired fields of the U. S. Fleet Numerical Weather Facility (FNWF) data and processing these data into ESSA format are reported. Five major stability levels and three parameters from FNWF grid files are the basis of a system of matrix equations. Solution of these equations produces the pressure and virtual temperatures at each mandatory level for that grid point. A CDC 1604 program is used to convert the FNWF 48-bit packed binary word records to the Weather Bureau National Meteorological Center 36-bit records. Data were taken twice daily, during the period 1 November 1961 through 31 January 1968, based on observations at 0000 Z and 1200 Z. The pressure surfaces of interest were the 1000, 850, 700, 500, and 300 mb levels.
B.P.

N68-33589 National Lending Library for Science and Technology, Boston Spa (England).
THE LATITUDINAL VARIATION OF THE STATE OF DISTURBANCE OF THE ATMOSPHERE
B. I. Sazonov [1968] 26 p refs Transl. into ENGLISH from Tr. Gl. Geofiz. Observ. (Leningrad), no. 211, 1967 p 3–16
(M-7371) Available from Natl. Lending Library, Boston Spa, Engl.

The latitudinal variation of the state of disturbance of the atmosphere at the 500 mb level in the Northern Hemisphere is studied on the basis of up-to-date data on the motion and focusing of cosmic particles in the earth's magnetic field. It is shown that the mean latitudinal variation of the atmospheric disturbance of the circulation in the troposphere, and all its special features, can be explained on the hypothesis of the presence of uniformly distributed sources of cosmic rays at elevation angles between + and −40° to the ecliptic. All six special features obtained from an analysis of the special features of the intrusion of cosmic rays were found in the latitudinal variation of the state of disturbance of the troposphere over the northern hemisphere. It is concluded from the data obtained that it is probable that the main reason for the disturbance of the middle and upper troposphere is the penetration of focused fluxes of medium energy cosmic rays into STORMER's impact zones. Solar activity affects the tropospheric circulation through an intermediate link—solar and galactic cosmic ray. Author

21 NAVIGATION

Includes guidance; autopilots; star and planet tracking; inertial platforms; and air traffic control. For related information see also: 07 Communications.

N68-32480# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
GUIDANCE OF BALLISTIC MISSILES
A. M. Zhakov and F. A. Pigulevskiy 1 Dec. 1968 68 p Transl. into ENGLISH from the publ. "Upravleniye Ballisticheskimi Raketami" Moscow, Voyennoye Izd. Min. Oborony SSSR, 1965 p 1–4, 146–210
(FTD-MT-24-304-67; AD-671656)

The book is intended for officers of the Soviet armed forces in the fields of engineering and technology and for rocketry students. The authors discuss ballistic-missile guidance in detail. Contents: Control of motion of the center of masses of the rocket, systems of lateral radio correction; Measurement of coordinates of the rocket in command systems of radio control. TAB

N68-32623# ARINC Research Corp., Annapolis, Md. Airlines Electronic Engineering Committee.
AIR TRANSPORT INERTIAL NAVIGATION SYSTEM (INS)
1 Jun. 1967 148 p *Its* ARINC Characteristic No. 561

Basic requirements are documented for an Inertial Navigation System (INS) that provides sensor and steering computations for commercial transport-type aircraft. Inertial sensing techniques are used and outputs are provided for aircraft attitude, present position, and steering signals for operating the pilots' instruments and the INS display unit. The basic INS provides complete self-contained navigation capability as well as outputs that could be used for vertical navigation and system management for supersonic transport applications. Standards required to effect interchangeability of operation modes are noted, and the system design considerations are reported. Design of the navigation, electronics, control/display, mode selector, and remote control and display units are reviewed. Standard signal characteristics and the basic digital signal standards are presented. M.W.R.

N68-32698# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
AUTOMATIC PROCESSING OF INFORMATION RECEIVED FROM PULSE NAVIGATION SYSTEMS WITH THE AID OF ELECTRONIC DIGITAL TECHNIQUES [AVTOMATICHESKAYA OBRABOTKA INFORMATSII, POLUCHAYEMOY OT IMPUL'SNYKH RADIONAVIGATSIONNYKH SISTEM, S PRIMENENIYEM ELEKTRONNOY TSIFROVOY TEKHNIKI]
V. A. Zhilin 3 Nov. 1967 22 p refs Transl. into ENGLISH from Tr., Tsentr. Nauchn.-Issled. Inst. Morsk. Flota (Leningrad), no. 51 1963 p 55–68
(FTD-HT-67-378; AD-671286)

The article deals with the basic problems of automatic processing of data received from the radio receiver of a pulse navigation system (automatic scanning, automatic tracking, measurement). It is shown that information-processing devices based on digital engineering display a number of advantages over analog devices. The information losses associated with the quantizing of the continuous random process are analyzed. The concept of efficiency of the quantizing device is introduced. The relation of this efficiency to the quantizing step is established. Author (TAB)

N68-32713# Arcon Corp., Wakefield, Mass.
STUDY OF FUTURE OCEANIC AVIATION SUPPORT SYSTEMS Final Report
May 1968 240 p refs
(Contract FA-67-WA-1680)
(SRDS-RD-68-23)

This report presents the results of an evaluation of the effectiveness of advanced communication and navigation technology in fulfilling the aviation support requirements anticipated for the North Atlantic Region in the 1975–1980 time period. A system approach developed alternative air traffic control system concepts using the various technological advances. The measure of effectiveness used to compare the alternative systems is based on the annual savings achieved by reducing the nominal separations between aircraft in the oceanic region under the assumption that current levels of safety are maintained. The body of the report presents the results of the analyses and discusses their interpretations. Detailed mathematical treatments are given in the Appendices: A. Traffic Analysis, B. Economic Penalties in a Parallel Track System, C. The Relationship of Risk of Collision to Separation Standards, D. Estimates of Future Communications Requirements in the North Atlantic. Author

N68-32732# Navy Electronics Lab., San Diego, Calif. Center for Command Control and Communications.
OMEGA-SYSTEM SYNCHRONIZATION IN THE ABSOLUTE MODE OF OPERATION Research and Development Report, Aug. 1964–Jan. 1968
C. R. Phipps, Jr. Mar. 1968 32 p ref
(NELC-1548; AD-671997)

Maintenance of station synchronization is of primary importance to the successful operation of the Omega navigation system. This report appraises several methods of synchronizing stations operating in the absolute mode, in which individual stations are not slaved to a master clock but rely mainly on clocks of their own. It recommends a method using a central computing facility and distributed station monitors. Author (TAB)

N68-32811# Federal Aviation Administration, Atlantic City, N. J. National Aviation Facilities Experimental Center.
ILS FLIGHT INSPECTION POSITIONING SYSTEM TEST AND EVALUATION Final Report
Glen D. Adams Sep. 1968 52 p
(NA-68-33; RD-68-35)

Technique feasibility hardware for an Instrument Landing System (ILS) Flight Inspection Positioning System (FIPS) has been tested. Positioning accuracy data show that the two standard deviation measures of dispersion were 0.03° in the initial part of the ILS approach. In the near area of the approach, the FIPS performance may have exceeded the capability of the measurement instrumentation. Static tests near the threshold produced a two standard deviation measure of dispersion of 0.01° and less. The flight inspection aircraft, measuring for effects on the commissioned ILS, report that the FIPS installation has no measurable influence on the ILS. With respect to providing guidance for flight inspection use, the FIPS produces courses, flyable simultaneously by a pilot when used in conjunction with a standard ILS. The conclusion is reached that the interferometer technique used is feasible as an accurate measurement system. Author

N68-32921# Joint Publications Research Service, Washington, D. C.

ACTIVE VARIANT OF A SATELLITE ANGLE-DISTANCE NAVIGATION SYSTEM

R. N. Perevezentsev 12 Aug. 1968 9 p ref Transl. into ENGLISH from Tr. Tsentr. Nauchn. Issled. Inst. Morsk. Flota (Leningrad), no. 69, 1966 p 44–48
(JPRS-46166)

This article examines algorithms for solving the problem of determining the location of a ship at sea with the aid of an active satellite system, based on the angle-distance measurement method of navigational observations. A general block diagram for this system is presented. Author

N68-33004# Federal Aviation Administration, Atlantic City, N. J. National Aviation Facilities Experimental Center.

TEST AND EVALUATION OF OVER-OCEAN SEPARATION ASSURANCE SYSTEMS Final Report

Anthony D. Bradley and Ronald S. Bassford Sep. 1968 122 p refs
(NA-68-38; RD-68-47)

Three airborne air-to-air ranging systems were evaluated to determine their capability to provide aircraft separation information in an over-ocean airspace environment, and to verify the technical characteristics of each system. The systems evaluated were: (1) TACAN Navigational Set AN/ARN-52(V); (2) Airborne Beacon Range/Altitude Monitor; and (3) Airborne Time/Frequency Range–Altitude Monitor. Flight tests confirmed the results obtained during the simulation effort which established the operational procedures for each system. The technical tests indicated that all three systems were suitable for operation in an over-ocean environment, but improvement should be made in the antenna coverage of the Airborne Beacon Range/Altitude Monitor and the synchronization of the Airborne Time/Frequency Range/Altitude Monitor employing a dual antenna feed configuration. It was recommended that the air-to-air ranging concept of the TACAN Navigational civilian distance measuring equipment, and that the Airborne Beacon Range/Altitude Monitor concept be considered provided the antenna coverage is omni-directional. Author

N68-33006*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

THE EFFECT OF SOME TELESCOPE FACTORS ON VARIABILITY OF PERFORMANCE IN SEXTANT SIGHTING

Robert J. Randle and Emmett C. Lampkin Washington Sep. 1968 24 p refs
(NASA-TN-D-4781) CFSTI: HC$3.00/MF$0.65 CSCL 17G

The use of a hand-held sextant for the acquisition of navigational information in space flight may be a practical and economical method for providing an emergency or supplemental navigation mode. Telescope objective lens diameter, aperture stop diameter, and magnification effects on the variability of a set of angular measurements made with a conventional marine sextant were investigated. Sighting variability performance improved monotonically with increasing telescope powers. Reductions in objective lens size and aperture size were also associated with improved performance. Subjects varied significantly in their sighting ability; subjects who had the poorest performance were helped most by higher magnifications. Performance changes due to magnification changes were dependent upon the objective lens size used. Performance changes due to changes in objective lens size depended upon the aperture size. Author

N68-33014*# National Aeronautics and Space Administration, Washington, D. C.

THE CELESTIAL GUARDIANS "CASTOR AND POLLUX" WILL SURVEY AIRPLANES CROSSING THE ATLANTIC ["CASTOR ET POLLUX," BERGERS CELESTES, SURVEILLERONT LES AVIONS TRAVERSANT L'ATLANTIQUE]

Jean-Claude Trichet Sep. 1968 9 p Transl. into ENGLISH from Air et Cosmos (France), no. 223, 2 Dec. 1967 p 29–31
(NASA-TT-F-11502) CFSTI: $3.00 CSCL 17G

The article describes the uses and functioning of the twin satellites "Castor and Pollux" according to a project prepared by French specialists. Special stress is laid on the expected future overcrowding of air space above the North Atlantic. The author deals with the risk of collisions, and the utilization of the satellite system for avoiding them. Author

N68-33015*# National Aeronautics and Space Administration, Washington, D. C.

THE "DIOSCURES" TWIN SATELLITES RECOMMENDED BY CNES AND SGAC FOR AERIAL NAVIATION ["DIOSCURES" SATELLITES JUMEAUX PROPOSES PAR LE CNES ET LE SGAC POUR LA NAVIGATION AERIENNE]

Jean-Claude Trichet Sep. 1968 6 p Transl. into ENGLISH from Air et Cosmos (France), no. 223, 2 Dec. 1967 p 16–17
(NASA-TT-F-11933) CFSTI: HC$3.00/MF$0.65 CSCL 17G

This article describes the purpose, technique, and financing of the French "Dioscures" twin-satellite project, to be used mainly over the North Atlantic, for locating airplanes. The author voices some criticism of Comsat's attitude towards the project and stresses the importance of "Dioscures" for European cooperation based on French initiative. Author

N68-33029*# National Aeronautics and Space Administration, Washington, D. C.

THE "DIOSCURES" FOR THE TACTICAL CONTROL OF AIRPLANES ABOVE THE NORTH ATLANTIC ["DIOSCURES" POUR LE CONTROLE (TACTIQUE) DES AVIONS SUR L'ATLANTIQUE NORD]

Sep. 1968 4 p Transl. into ENGLISH from Air et Cosmos (France), 25 Nov. 1967
(NASA-TT-F-11934) CFSTI: HC$3.00/MF$0.65 CSCL 17G

The article deals with the "Dioscures" Project: a 2-satellite system to aid and control airplanes above the North Atlantic. Author

N68-33160# Bunker-Ramo Corp., Canoga Park, Calif.

PILOT FAILURE DETECTION PERFORMANCE WITH THREE LEVELS OF FAULT WARNING INFORMATION Final Report, 20 Mar.–26 Apr. 1967

D. Vreuls, S. F. Barnebey, D. E. Nichols, and P. L. Dent Feb. 1968 143 p refs
(Contract FA-67-WA-1700)
(FAA-RD-68-9; AD-671892)

A study was made to examine the feasibility of display and control concepts for commercial subsonic jet transport all-weather (Category III) approach and landing. The study was addressed primarily to fault warning. Pilot detection of autopilot and display system failures was examined with three levels of fault warning display information. Display failure detection and pilot decisions were additionally examined as a function of pilot task load, manual in one axis or automatic. A total of 702 simulated ILS approaches were flown by 18 commercial airline pilots in a Boeing 707-720B research simulator. Pilot/system performance and preference data indicated that the full annunciator display system tested was required in order to attain the best display failure and passive autopilot control failure detection. The failure warning utility of mode progress information below 200 feet of altitude on the approach was found to be inadequate. The data suggested that: (1) mode progress information be de-emphasized, (2) manual control of just one axis causes pilot fault-detection performance to deterioriate compared to monitoring full autopilot operation, (3) second failures following first failures which put the pilot into split-axis control were frequently missed, and (4) there is not enough time from 100 feet to landing to allow any complicated land-or-go-around decision process. Some general characteristics of fault warning displays were discussed. Author (TAB)

N68-33176*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

MANNED SPACECRAFT NAVIGATION GUIDANCE AND CONTROL

Brent Y. Creer *In its* Aerospace Electron. Systems Technol. 1967 p 111-123 (See N68-33169 20-30)

Several examples of NASA's effort in the research, development, and test of manned spacecraft guidance and control systems are reviewed in order to define potential problem areas; illustrate possible approaches to their solution; and cite new technology that could influence the design of the next generation of such spacecraft systems. Navigation, guidance, and control problems that might be resolved by the intervention of the spacecrew are emphasized; consideration is limited to the launch, reentry, and midcourse phases of the mission. Among the conclusions reached are the following: (1) A substantial payoff in reliability may be realized by using the crew in controlling advanced aerospace vehicles through a backup control system. (2) Improved simplified crew-oriented backup entry guidance systems are required. (3) An assessment should be made of the effect of new sextant technology on the design concepts of primary guidance systems, and on the analysis of simplified onboard backup guidance systems to provide safe return. (4) Systems management capability of the crew should be one of the prime considerations in onboard digital computer system design. M.G.J.

N68-33182*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.

UNMANNED SPACECRAFT GUIDANCE AND CONTROL

John R. Scull *In* NASA. Washington Aerospace Electron. Systems Technol. 1967 p 189-205 (See N68-33169 20-30) (Contract NAS7-100)

The guidance and control technology used in unmanned lunar and planetary spacecraft is described in relation to the spin stabilization employed in the Pioneer series, and the three-axis stabilization used in the Ranger, Mariner, Surveyor, and Lunar Orbiter spacecraft. Present and potential problem areas are identified as reliability, long operating times, greater mission complexity, increasingly severe environments, troublesome electromechanical devices, and the difficulties of performing realistic preflight simulation tests. Future mission requirements are defined as (1) planetary soft-landing guidance; (2) roving vehicle navigation and control; (3) guidance and control of electrically propelled spacecraft; (4) autonomous spacecraft guidance systems involving more onboard complexity, autonomous sensing and computing, greater accuracy and reliability, and increased computer capability. Stress is placed on the need for advancing the technology in order to make possible the Voyager missions during the mid-1970's, and the longer duration missions to the comets, asteroids, or the more distant planets. M.G.J.

N68-33183*# National Aeronautics and Space Administration. Electronics Research Center, Cambridge, Mass.

RESEARCH ON STRAPDOWN GUIDANCE-AND-CONTROL SYSTEMS FOR ADVANCED UNMANNED LAUNCH VEHICLES

Robert C. Duncan *In its* Aerospace Electron. Systems Technol. 1967 p 207-219 (See N68-33169 20-30)

The relative advantages of strapdown systems and gimbaled systems are assessed, and the opinion is offered that strapdown systems offer some advantages in that rate information is measured directly by the gyros, while in the gimbaled systems rate information is derived by combining geometrically the angular motion of the gimbals. In strapdown systems, the gyros are considered to present the greatest problems because their mode of operation changes most drastically in going from gimbaled to strapdown systems; also, both gyros and accelerometers are subject to more strenuous linear and angular vibration environments than their gimbaled counterparts. To advance technology in areas where the strapdown systems are of more value than platform systems, research is being conducted on further power and weight reduction, reliability improvement, optimal sensor orientation, in-flight shutdown capability, and new algorithms. It is concluded: (1) Strapdown systems will probably become common in future mannad and unmanned spacecraft and in launch vehicles where extremely high performance is not required. (2) The difficult environment in aircraft systems has ruled out the use of strapdown systems to date. M.G.J.

N68-33187*# National Aeronautics and Space Administration. Flight Research Center, Edwards, Calif.

A REVIEW OF AVIONICS REQUIREMENTS FOR GENERAL AVIATION

Shu W. Gee *In its* Aerospace Electron. Systems Technol. 1967 p 261-272 (See N68-33169 20-30)

As pilot error is the main cause of accidents, research is being conducted by NASA to provide the general aviation pilot with an aircraft or systems that will reduce his workload to a point where he can efficiently and safely manage the aircraft in flight. The areas being studied include (1) a lateral stability augmentation system employing a single tilted gyro which senses a combination of yaw rate and roll rate; (2) automatic activation and recovery performance of a safety system as a safeguard against overspeeds caused by disorientation during instrument flight which could cause structural failure; (3) a fluid flight-control system for a small executive-type aircraft; and (4) development of fluidic components and techniques. Planned work encompasses control system integration; improved display system concepts and their integration with the control system for optimum control harmony; simplified approach and landing aids; and a cooperative Doppler radar technique using random coding to permit a number of aircraft to operate simultaneously in a radar system without frequency or time-slot assignments. M.G.J.

N68-33188*# National Aeronautics and Space Administration. Electronics Research Center, Cambridge, Mass.

COMMUNICATIONS AND NAVIGATION SATELLITES AS AERONAUTICAL AIDS

L. C. Van Atta *In its* Aerospace Electron. Systems Technol. 1967 p 273-281 (See N68-33169 20-30)

Two ways in which synchronous satellites could provide better position information for air traffic control (ATC) are cited: (1) Aircraft-derived position information can be communicated to the ground ATC facility via the satellite, using either voice or digital communications. (2) Aircraft positions can be determined independently by a satellite-based surveillance system and communicated to the ATC facility. As an indication of the studies devoted to systems concepts, some methods of navigation or position determination are described briefly. These include distance-measurement navigation, range–angle–angle navigation, crossed fan-beam navigation satellite using two beams at right angles, and determination of position from the Doppler shift as used in the Transit project navigational satellite system. The objectives and accomplishments of the Ad Hoc Joint Navigation Satellite Committee are reviewed. Summary data are presented on the results obtained from the ATS-1/aircraft voice communications experiment. Also reported is a proposed system study on the conceptual feasibility of an L-band satellite-aided communications system for the SST. M.G.J.

N68-33189*# National Aeronautics and Space Administration. Electronics Research Center, Cambridge, Mass.

INTEGRATED SUPERSONIC TRANSPORT AVIONICS

Richard M. Head *In its* Aerospace Electron. Systems Technol. 1967 p 283–290 (See N68-33169 20-30)

An overview is presented on the studies being directed toward identifying those avionic technologies that would make the greatest contribution to the safe, reliable, and economic operation of advanced high speed commercial aircraft for the latter 1970s and 1980 time period. These future systems are also being examined from the viewpoint of the gains to be realized both through a totally integrated avionics system aboard the aircraft itself, as well as through consideration of the aircraft as part of the vast, complex system that is global air transportation. Particular problem areas are identified as (1) the feasibility of meeting the long range, two-way communication requirement by means of a satellite-aided system operating at L-band frequencies; (2) new operational concepts in guidance and navigation, and new inertial sensor technology; (3) onboard instrumentation to maintain optimum flight profiles; (4) information processing concepts; and (5) ground based and inflight simulation of control and display systems. Also discussed is the approach to an analysis, synthesis, and engineering effort to integrate avionic subsystem elements into various candidate system configurations. M.G.J.

N68-33271*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

A MANUAL NAVIGATION METHOD FOR EVALUATING TRANSFER ORBITS FOR LUNAR LANDINGS

G. Kimball Miller, Jr. Washington Sep. 1968 41 p refs

(NASA-TN-D-4756) CFSTI: HC $3.00/MF $0.65 CSCL 22C

An analytical investigation has been made of a manual navigation method which permits an astronaut in the lunar-landing module to evaluate his orbit as he transfers from an 80-nautical-mile (148.16-kilometer) altitude circular orbit to a point approximately 50,000 feet (15,240 meters) above the lunar surface. The method can also be used to predict the altitude and velocity components at the point of nominal powered-descent initiation. When the local horizontal is known, the method requires only the astronaut's use of a sextant to measure the elevation angle to the command module and the depression angle to the lunar horizon relative to the local horizontal at a single specified measurement point and four simple guidance charts. The navigation method was evaluated for various off-nominal transfer orbits and measurement errors. It was found that the accuracy of the method was enhanced by choosing the measurement point located as late as possible in the transfer orbit. With the measurement point located 40° prior to the point of nominal powered-descent initiation, the basic navigation method generally predicts the altitude of the landing module at pericenter and at the point of powered-decent initiation to within 2500 feet (762.0 meters). The corresponding predicted velocity components at nominal powered-descent initiation are generally within ±4 feet per second (1.22 meters per second) of the actual values. The prediction error experienced under the influence of selected measurement errors (including an optical determination of the local horizontal) are approximately double those of the basic mehtod. Author

N68-33450*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

INFRARED HORIZON PROFILES FOR SUMMER CONDITIONS FROM PROJECT SCANNER

Thomas B. McKee, Ruth I. Whitman, and Richard E. Davis Washington Aug. 1968 125 p refs

(NASA-TN-D-4741) CFSTI: HC $3.00/MF $0.65 CSCL 17G

Measured horizon radiance profiles in spectral bands of 615 cm^{-1} to 715 cm^{-1} (CO_2) and 315 cm^{-1} to 475 cm^{-1} (H_2O) from Project Scanner flight of August 16, 1966, are shown. Data cover a latitude range from 10°N to 57°N. Excellent agreement between measured and independently analytically predicted radiance profiles in the CO_2 region confirms that the analytical technique is within the experimental accuracy. The agreement of measured with predicted profiles and the lack of dependence on the presence of clouds indicate that the 615 cm^{-1} to 715 cm^{-1} spectral region is a leading choice for attitude determination applications. Horizon profiles in the 315 cm^{-1} to 475 cm^{-1} spectral region show a strong dependence on the presence of clouds. Mixing ratios of water vapor deduced from the radiance measurements indicate little latitudinal variation and are less than 0.017 g/kg at altitudes between 16 km and 33 km. Author

N68-33456*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

THE EFFECTS OF IRRADIATION AND STAR MAGNITUDE ON SEXTANT SIGHTING PERFORMANCE

Robert J. Randle and Emmett C. Lampkin Washington Sep. 1968 11 p refs

(NASA-TN-D-4780) CFSTI: HC $3.00/MF $0.65 CSCL 17G

A hand-held sextant may provide a practical and economical method of acquiring navigational information in space flight during an emergency or to supplement other navigation measurements. If this mode is chosen for space flight, it is mandatory that the limits of human performance with the sextant be established. The present study was designed to investigate variables which may affect sighting accuracy. Male college students with good visual acuity (Snellen 20/20 or better) and normal color vision were trained to make angle measurements with a marine sextant. The sextant was gimbal mounted and angle readings were recorded with a digital shaft encoder mounted on the shaft of the sextant vernier knob. In measuring the angular subtense of a simulated planetary disk, increases in disk brightness were associated with increases in the measured subtense. Changing the magnitude of the reference star did not significantly affect performance. Author

N68-33505 Joint Publications Research Service, Washington, D. C.

SELECTION OF SPACE BEACON ORBITS FOR CONTINUOUS-OPERATION NAVIGATION SATELLITE SYSTEMS

Ye. N. Perevezentsev 26 Aug. 1968 22 p refs Transl. into ENGLISH from Tr. Tsentr. Nauchn.-Issled. Inst. Morsk. Flota (Leningrad), no. 83, 1967 p 64–75

(JPRS-46281) CFSTI: $3.00

A network of uncontrolled satellites for global navigation satellite systems in specified longitude and latitude bands of the earth's surface is considered. The proposed solutions for using

these networks are based on the theory of Keplerian motions of the satellites in the central gravitational field of the spherical earth model. Formulas which account for maximal and minimal latitudes of the zone of action of the satellite system are derived, and are used to determine the required number of orbital planes and number of artificial earth satellites (AES). The use of circular orbits of diurnal AES and elliptic orbits of equatorial AES is advised in designing these systems for service over the longitude bands of the earth. For navigation service in the latitude bands of the earth's surface, the use of circular orbits with AES, which are uniform along the orbit and equidistant from one another, is recommended. B.P.

N68-33587# IIT Industrial Labs., Fort Wayne, Ind.
BRIGHT RADAR INDICATOR TOWER EQUIPMENT (BRITE-1) Final Report, 24 Feb.–31 Dec. 1967
Nelson Hoag and Ike Studebaker May 1968 40 p
(Contract FA-67-WA-1695)
(SRDS-RD-68-28)

The features of this equipment are improved display brightness, better contrast capabilities, and improved decay characteristics over displays currently in use with the airport surveillance radar ASR-4. The system consists of a closed circuit vidicon TV camera optically coupled to a 5-inch plan position indicator which converts rho-theta information for display on a rectangular TV display unit. Problem areas and unique aspects encountered during development and field evaluation of the prototype equipment are discussed in this report in order to achieve an optimum design for fabrication and operation. K.W.

22 NUCLEAR ENGINEERING

Includes nuclear reactors and nuclear heat sources used for propulsion and auxiliary power. For basic research see: 24 Physics, Atomic, Molecular, and Nuclear. For related information see also: 03 Auxiliary Systems; and 28 Propulsion Systems.

N68-32684# Idaho Nuclear Corp., Idaho Falls. National Reactor Testing Station.
THE USE OF A PROTON-RECOIL SPECTROMETER WITH PULSE SHAPE DISCRIMINATION FOR SPECTRUM MEASUREMENTS IN WATER MODERATED REACTORS
J. E. Powell May 1968 20 p refs
(Contract AT(10-1)-1230)
(IN-1054) CFSTI: HC $3.00/MF $0.65

Proton and gamma ray rate-of-rise distributions were measured in the core of the Advanced Reactivity Measurement Facility II (ARMF-II) to demonstrate the feasibility of using proton-recoil neutron spectrometer with pulse shape discrimination for spectrum measurements in a thermal reactor. A hydrogen filled proportional counter was used to obtain the data for proton energies over the range of 5 to 100 keV. A high residual gamma ray background present in the ARMF-II core prevented measurements below 5 keV. No gamma ray events were observed in the rate-of-rise distributions above 60 keV. Author (NSA)

N68-32694# Atomic Energy Establishment, Winfrith (England).
HOMOGENISATION OF A WIGNER–SEITZ CELL IN TWO GROUP DIFFUSION THEORY
F. R. Allen Feb. 1968 17 p refs
(AEEW-R-594) CFSTI: HC $3.00/MF $0.65

Two group diffusion theory is used to develop a theory for the homogenization of a Wigner–Seitz cell, neglecting azimuthal flux components of higher order than dipoles. An iterative method of solution is suggested for linkage with reactor calculations. The limiting theory for no cell leakage leads to cell edge flux normalization of cell parameters, the current method for core representation in SGHW reactor design calculations. Numerical solutions are presented for cell-plus-environment model with monopoles only. The results demonstrate the exact theory in comparison with the approximate recipes of normalization to cell edge, moderator average, or cell average flux levels. Author (NSA)

N68-32703 Polytechnic Inst. of Brooklyn, N. Y.
THERMOELASTIC BOWING OF COMPOSITE CYLINDRICAL FUEL RODS
Brook Leo Hunter (Ph.D. Thesis) 1967 107 p
Available from Univ. Microfilms: HC $5.40/MF $3.00 Order No. 67-13396

The thermoelastic bowing of axially unrestrained nuclear fuel rods due to a transversely linear internal heat generation rate is investigated in this dissertation. The problem consists of first determining the steady-state, two dimensional temperature distribution in the circular cross section of the rod and then solving for the corresponding stresses and displacements. The thermoelastic problem is solved with aid of the Airy stress function. For constant material properties the problem is solved exactly. For temperature-dependent material properties, an approximate method is used, with the fuel rod replaced by a number of concentric layers, each assumed to have constant material properties. Solution given by the approximate method is in the form of the infinite series. The axial stress produces a resultant moment when integrated over the cross section of the rod. Dissert. Abstr.

N68-32780# TRW Equipment Labs., Cleveland, Ohio.
MERCURY BOILER DEVELOPMENT ON THE SNAP 2/MRPC PROGRAM Research and Development Report, 1958–1967
R. J. Ziobro and A. E. Koestel 3 Jun. 1968 123 p refs /ts
Topical Rept. No. 34
(Contract AT(04-3)-690)
(TRW-690-32; TRW-ER-7252) CFSTI: HC $3.00/MF $0.65

The entire SNAP 2/MRP boiler research and development program from 1958 through 1967 is summarized. The heat transfer, hydrodynamics, mechanical design, test results, and metallurgical results are presented in a chronological sequence with the text material abstracted from previously published reports. An assessment of the current status of the developed boiler hardware and the boiler design technology is made. Author (NSA)

N68-32953# Los Alamos Scientific Lab., N. Mex.
THERMAL IRRADIATION OF LIQUID PLUTONIUM ALLOY FUELS
R. L. Cubitt, G. L. Ragan, and D. C. Kirkpatrick 4 Jun. 1968 20 p refs
(Contract W-7405-ENG-36)
(LA-3832) CFSTI: HC $3.00/MF $0.65

In-pile test loops for irradiating liquid plutonium-alloy fuels were operated in the Omega West Reactor. These loops provided a sodium environment for test fuel capsules at temperatures similar to those expected for liquid metal cooled fast breeder reactors. Eleven fuel capsules were irradiated with up to 2.6 at.% burnup of plutonium. The design, construction and operation of the irradiation loops and the handling of the irradiated test fuel capsules are described. Author (NSA)

N68-32968*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
ELECTRON-BOMBARDMENT FILAMENT DESIGNS FOR HEATING CYLINDRICAL THERMIONIC CONVERTERS
Peter Cipollone Washington Aug. 1968 20 p refs
(NASA-TM-X-1630) CFSTI: HC$3.00/MF$0.65 CSCL 18N

The effect of axially varying the pitch of helical electron-bombardment heaters on the axial distribution of radial heat flux to an internally heated hollow cylinder was investigaged; the cylinder simulating the electron-emitting electrode of a thermionic converter. Measured axial distributions of temperature and corresponding calculated heat fluxes are presented for a series of five variable-pitch filaments and for mean emitter-surface temperatures of 1778 to 2038°K. These results are compared to similar data obtained with a uniform-pitch filament. Author

N68-32981# Institutt for Atomenergi, Halden (Norway).
THE FUEL DYNAMICS OF A THIN-WALLED METALLIC URANIUM TUBULAR ASSEMBLY, 1964–1966
F. I. Toepfner Dec. 1967 51 p refs
(HPR-89)

The fuel dynamics of a thin-walled metallic uranium tubular assembly are studied experimentally and theoretically. Transfer functions from power to heat flux and power to average fuel temperature are determined. The power is perturbed by varying sinusoidally the reactivity by a reactivity oscillator placed in the center of the core. The heat flux responses can be measured up to a frequency of 1.2 Hz by means of fast thermocouples attached to the canning of the fuel. The responses of the average fuel temperature are determined up to a frequency of 2.0 Hz by means of a fuel elongation detector. The accuracy, in terms of standard deviation, is 1 db for the gain and 5 degrees for the phase. The effect of changes in power level, subcooling and pressure is measured. The main fuel time constant is found to be approximately 1 second both by theory and by experiment. Author (NSA)

N68-32983*# General Electric Co., Pleasanton, Calif.
THERMAL CONDUCTIVITY OF COATED PARTICLE URANIUM DIOXIDE TUNGSTEN CERMETS
L. N. Grossman Washington NASA Aug. 1968 27 p refs
(Contract NAS3-8511)
(NASA-CR-1154) CFSTI: HC$3.00/MF$0.65 CSCL 18J

The thermal conductivity of cermets fabricated by hot-pressing of tungsten (W) coated uranium dioxide (UO_2) was measured. Data obtained from specimens containing nominally 80 and 60 volume percent UO_2 were compared with theoretical predictions based on Bruggman's model. Excellent agreement was found between theory and experiment in the 80 volume percent case in the temperature range of 900 to 1500°C. Less satisfactory agreement was obtained in the 60 volume percent case between 600 and 1700°c; the discrepancies could not be explained. The experimental technique, specimen preparation, experimental results and post-experiment metallography are presented. Author

N68-33001# Centre d'Etude de l'Energie Nucleaire, Mol (Belgium).
THERMAL BEHAVIOR OF CERAMIC URANIUM AND PLUTONIUM OXIDE FUELS UNDER IRRADIATION AT HIGH SPECIFIC RATINGS Special Report No. 9
Dec. 1967 82 p refs Transl. into ENGLISH from French
(Contract EURATOM-001-64-1TRUB)
(EURAEC-1999; EUR-3792) CFSTI: HC$3.00/MF$0.65

Techniques used in fabrication and inspection of UO_2–PuO_2 fuel rods produced from sintered oxide powders are described. Results of in-pile irradiation tests conducted on the rods, in the Br-2 reactor, are reported. NSA

N68-33078# Oak Ridge National Lab., Tenn.
REACTOR OPERATOR STUDY HANDBOOK (PROGRAMMED INSTRUCTION VERSION). VOLUME 3: REACTOR PHYSICS
R. A. Castner, Jr., E. N. Cramer, R. L. Scott, Jr., C. D. Cagle, ed., and S. D. Sheppard, ed. Jun. 1968 228 p refs
(Contract W-7405-ENG-26)
(ORNL-TM-2034, V. 3) CFSTI: HC$3.00/MF$0.65

Material on the physics of nuclear reactors is presented in the form of small frames which contain information in easily digestible steps. Self-test questions are included at the end of each section for review. Separate sections discuss: neutron reactions, nuclear reactors, reactivity and reactor period, fuel burnup, xenon and samarium poisoning effects, temperature effects, and neutron flux distribution. NSA

N68-33086# Los Alamos Scientific Lab., N. Mex.
STATUS OF THE LOS ALAMOS NUCLEAR ROCKET PROGRAM
Franklin P. Durham 1968 5 p Presented at AIAA 4th Propulsion Specialist Conf., Cleveland
(Contract W-7405-ENG-36)
(LA-DC-9589; CONF-680609-2) CFSTI: HC$3.00/MF$0.65

The effort in the Rover program at the Los Alamos Scientific Laboratory during the past year has been divided between preparing for the Phoebus 2A 5000 megawatt reactor test and the development and evaluation of improved fuel elements and reactor support materials. Phoebus 2A, which is now ready for testing, has been designed for highest power, power density, and chamber temperature in the Rover program to date. Facility modifications and checkout have been completed with a dual turbopump feed system capable of delivering 285 lb/sec of liquid hydrogen at 1300 psi. To provide a realistic environment for fuel element evaluation a small fuel element test reactor, Pewee 1, has been designed and fabricated with a first test planned late in the year. Significant progress has been made in the development of zirconium-uranium-carbide/carbon composite fuel elements that offer the promise of longer operating life than the present graphite-based fuel elements with a modest increase in temperature. Progress has also been made in the pure zirconium-uranium carbide system that will be capable of significantly higher temperatures than the present elements for useful operating times. Author (NSA)

N68-33087# Los Alamos Scientific Lab., N. Mex.
NUCLEAR SAFEGUARDS APPLICATIONS OF Cf^{252} SPONTANEOUS FISSION NEUTRON SOURCES
G. Robert Keepin 1968 15 p Presented at AEC Transplutonium Program Comm. Meeting, Washington, D. C.
(Contract W-7405-ENG-36)
(LA-DC-9552; CONF-680434-1) CFSTI: HC$3.00/MF$0.65

The merits of ^{252}Cf spontaneous fission neutron sources for use in the nondestructive detection, identification, and analysis of fissionable materials on the basis of their delayed-neutron kinetic response to fast-neutron irradiation are outlined. The sensitivity of the method for discrimination between fissionable isotopes is briefly discussed, and some possible source and detector configurations are indicated. NSA

N68-33088# Gulf General Atomic, Inc., San Diego, Calif.
THE GAF/GAR/GAND FAST REACTOR CROSS SECTION PREPARATION SYSTEM. VOLUME 1: GAFGAR: A PROGRAM FOR THE CALCULATION OF NEUTRON SPECTRA AND GROUP-AVERAGED CROSS SECTIONS
R. J. Archibald and D. R. Mathews 22 Jan. 1968 152 p refs
(Contract AT(04-3)-167)
(GA-7542, V. 1) CFSTI: HC$3.00/MF$0.65

The GAFGAR program is a combined and considerably revised version of the GAF and GAR programs featuring fully automated multigroup cross section combining and punching routines and problem repeat options as well as much faster recursive slowing down calculation in the GAR section and more efficient data tape formats. The purpose of GAFGAR is to accurately and efficiently solve the B_1 equations for neutron flux and current distributions as functions of energy considering explicitly the possible overlap effects between resonances of a resonance absorber and of mixtures of resonance absorbers and to use these distributions to prepare group-averaged cross sections and transfer arrays for use in fast reactor analyses. The program is written in FORTRAN-IV and has been run on a UNIVAC-1108 computer. Author (NSA)

N68-33089# Los Alamos Scientific Lab., N. Mex.
SCALE MODEL TESTS OF A NUCLEAR ROCKET EXHAUST SCRUBBER
Keith Boyer, Charles Fenstermacher, Ernest Bryant, and Karl Meier 1968 10 p refs Presented at AIAA 4th Propulsion Specialist Conf., Cleveland
(Contract W-7405-ENG-36)
(LA-DC-9555; CONF-680609-1) CFSTI: HC $3.00/MF $0.65

Measurements made during ground tests of Rover and Nerva nuclear rocket reactors, have shown that significant amounts of fission products are released from the fuel elements into the exhaust of the rocket and that these fission products can be carried considerable distances by atmospheric winds. An investigation was made to determine the feasibility of reducing this fission product release to the atmosphere. A concept based upon a water scrubbing system was developed and shows promise in achieving this goal. A furnace was built to produce simulated nuclear rocket exhaust containing fission products at design conditions. The effluent from this furnace was run through a scale model scrubber. Several runs were made and the results indicate that about 80% of the fission product iodine and its precursors, as well as other fission products, can be removed from the exhaust-gas stream by this method. Author (NSA)

N68-33132# General Electric Co., Pleasanton, Calif. Nucleonics Lab.
THE THERMAL CONDUCTIVITY OF URANIUM DIOXIDE BY DIRECT IN-REACTOR MEASUREMENT
D. H. Coplin, H. Hausner, M. F. Lyons, and B. Weidenbaum Sep. 1967 46 p refs Sponsored in part by EURATOM
(Contract AT(04-3)-189)
(GEAP-5100-6; EURAEC-2032) CFSTI: HC $3.00/MF $0.65

Direct in-reactor measurements were made of the thermal conductivity of sintered pellet and vibratory compacted UO_2 fuel to temperatures as high as 2750°C. The basic measurement technique was the use of gas bulb thermometer to sense the UO_2 central temperature in an irradiation capsule with simultaneous measurement of the capsule heat generation by calorimetry. The experimental thermal conductivity measurements for pellet UO_2 fuel are in substantial agreement with previously reported data based on indirect methods. However, development of the temperature sensor device was conducted concurrently with the capsule irradiations to measure thermal conductivity. A critical review of all the experimental data since completing the irradiations have revealed an inconsistency in the out-of-pile calibration results that detracts from the reliability of the sensor calibration technique. Consequently, the confidence in the absolute accuracy of the in-pile measurements is also reduced. Author (NSA)

N68-33205# Atomics International, Canoga Park, Calif.
LARGE RADIOISOTOPE HEAT SOURCE CAPSULE (LRHSC) Quarterly Progress Report, Jan.–Mar. 1968
22 Apr. 1968 135 p
(Contract AT(29-2)-2338)
(AI-AEC-12676; QPR-3) CFSTI: HC $3.00/MF $0.65

The Large Radioisotope Heat Source Capsule (LRHSC) Program was established to develop the technology for an isotope fuel capsule capable of operating in a space environment at a surface temperature of about 2000°F for five years or more. Progress is reported on the design, fabrication, testing, and evaluation of a test capsule which will meet the operating requirements. Specifications for the manufacture of both the reference design capsule and test items required for the program are presented. The following accomplishments are reported: reports were issued on materials specifications and ceramic coating process development and evaluation; a brazing procedure was developed for joining the Ta–10W pressure feed-through tube from the creep capsule to a SS pressure tube; the best heat treating cycle for the T-111 structural shell was identified; and an electron beam welder for 100% penetration welds of the feed-through tube and the structural shell was installed and checked, and the resulting welds were examined by ultrasonic and metallographic techniques and found to meet the requirements. NSA

N68-33238*# National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.
A SNAP-8 BREADBOARD SYSTEM. OPERATING EXPERIENCE.
J. N. Hodgson (Aerojet-General Corp., Azusa, Calif.) and R. P. Macosko Aug. 1968 35 p refs Presented at the IEEE Intersoc. Energy Conversion Eng. Conf., Boulder, Colo., 13–16 Aug. 1968
(NASA-TM-X-61161; Rept.-3511) CFSTI: HC $3.00/MF $0.65
CSCL 18N

SNAP-8 is a 35 kw nuclear-electric space power system. The system operates on a mercury Rankine cycle using NaK (eutectic sodium-potassium mixture) as the heat-input and heat-rejection working fluids. The test program has evolved from an initial component test phase to testing of complete breadboard systems. Extensive testing has provided information on the relationships between components and the system. Data are presented showing the perturbations, and their consequences, inherent in a dynamic system. Cause and effect relative to boiling instability, system contamination, inventory control, testing mishaps, and transient operation are presented as observed during the test program. The breadboard approach to system testing and design has proven appropriate. A close simulation to flight-configuration testing has been accomplished while maintaining the design flexibility of a breadboard system. Author

N68-33253# Oakridge National Lab., Tenn.
REACTOR OPERATOR STUDY HANDBOOK (PROGRAMMED INSTRUCTION VERSION). VOLUME 5: INSTRUMENTATION AND CONTROLS
R. A. Costner, Jr., E. N. Cramer, R. L. Scott, Jr., C. D. Cable, ed., and S. D. Sheppard, ed. Jun. 1968 257 p refs
(Contract W-7405-ENG-26)
(ORNL-TM-2034, V. 5) CFSTI: HC $3.00/MF $0.65

Information on the basic aspects of nuclear reactor instrumentation and controls is presented in the form of frames which contain data in small, easily digestible steps. Separate sections include: principles of electricity, radiation detection, philosophy of reactor control, control instrumentation, instrument behavior during an orderly reactor startup, and process instrumentation. Self-test questions for review are included at the end of each section. NSA

N68-33276# Naval Research Lab., Washington, D. C.
METALLURGICAL FAILURE ANALYSIS OF PM-3A REACTOR CONTROL ROD LIFTING KNOB

J. R. Hawthorne, C. Z. Serpan, Jr., R. A. Gray, Jr., H. E. Watson, O. R. Gates et al 14 Jun. 1967 28 p
(NRL-MEMO-1788; AD-656579)

A metallurgical analysis has been performed upon a failed control rod cap from the Navy PM-3A Nuclear Power Plant. Material supplied to the Metallurgy Division for this investigation was the lifting knob which had separated in service from the main body of the cap. The specific objective of the analysis was to determine if the material of application met design specifications and to determine the probable cause of component failure. Compositional analysis by X-ray spectrochemical and gravimetric techniques established that the lifting knob, and thus the failed control rod cap, was fabricated from a 300 series stainless steel, not from 17-4 PH precipitation hardening stainless steel as specified. Microstructural and hardness examinations further confirmed the substitution of a 300 series stainless steel for the 17-4 PH steel composition. Examination of the stem of the control rod cap knob at which failure occurred revealed severe "necking down" and heavy striations corresponding to work hardening lines. This visual evidence coupled with analytical evidence of a low strength material of application suggests component failure through gross overload. Author (TAB)

N68-33289# Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.
SOME PROPERTY MEASUREMENTS ON PROMETHIUM SESQUIOXIDE
R. L. Gibby, T. D. Chikalla, R. P. Nelson, and C. E. McNeilly 18 Apr. 1968 31 p Presented at the Natl. Meeting of the Am. Ceram. Soc., Chicago, 22–25 Apr. 1968
(Contract AT(45-1)-1830)
(BNWL-SA-1796; CONF-680408-2) CFSTI: HC $3.00/MF $0.65

Promethium-147 has nuclear properties which are desirable for isotopic power source applications; the sesquioxide of promethium is one of the fuel forms currently being evaluated. Properties which were measured in this investigation were melting temperature, thermal expansion, thermal diffusivity, and electrical resistivity. In addition, thermal conductivity was calculated from the thermal diffusivity data and estimated heat capacities. The decomposition of promethium oxalate and formation of the oxide was studied by differential thermal analyses. Since promethium-147 transforms to samarium-147 through a beta-decay process with a half-life of 2.62 years, measurements were necessarily made on Pm_2O_3–Sm_2O_3 alloys, the samarium content being established by the decay time allowed prior to a particular measurement. Samples of Pm_2O_3, purposely doped with Sm_2O_3, showed large variations in melting temperature indicative of a wide solid plus liquid field. Author (NSA)

N68-33316# Westinghouse Electric Corp., Pittsburgh, Pa. Atomic Power Div.
EXAMINATION OF CVTR COMPONENTS
W. R. Smalley, E. Paxson, L. P. Hornak, and M. B. Jones Jun. 1967 76 p refs
(CVNA-289) CFSTI: HC $3.00/MF $0.65

As part of a program to evaluate the irradiation performance of CVTR components, one of the highest exposure Zircaloy pressure tubes from Core I was sectioned and subject to non-destructive and destructive examinations. In addition, several of the black control rods were measured after Core I service to determine the extent of irradiation-induced bow. Optical microscopy revealed no changes in basic microstructure as a result of irradiation. The mechanical property changes were evaluated by microhardness measurements, ring flattening tests and hot burst tests. This examination confirms the excellent performance of Zircaloy-4 as a pressure tube material in the CVTR. A control rod bow measuring device, utilizing linear variable differential transformers, was shown to be capable of making reliable measurements to ±0.01 inch. The measurements indicated that some control rod bow had occurred–up to 0.93 in.–but did not cause any operational problems in CVTR. Author (NSA)

N68-33323# Oak Ridge National Lab., Tenn. Metals and Ceramics Div.
FABRICATION PROCEDURES FOR MANUFACTURING HIGH FLUX ISOTOPE REACTOR FUEL ELEMENTS
R. W. Knight, J. Binns, and G. M. Adamson, Jr. Jun. 1968 180 p refs
(Contract W-7405-ENG-96)
(ORNL-4242) CFSTI: HC $3.00/MF $0.65

A production procedure was developed for manufacturing High Flux Isotope Reactor fuel assemblies. The entire fuel assembly of this reactor is made up to two fuel elements, each element consisting of an annular array of fuel plates. These annuli are identified as the inner and outer fuel elements. The inner element consists of 171 identical fuel plates and the outer element consists of 369 identical fuel plates differing slightly from those in the inner element. Both sets of fuel plates contain U_3O_8 powder as the fuel dispersed in an Al powder matrix and clad with Al. Procedures for manufacture and inspection of the element are described and illustrated. The procedures described have been used to manufacture 46 fuel assemblies for operation at 100,000 kW. No fuel element has been rejected, but no fuel element has been manufactured that meets all of the specification requirements. The deviations that have been accepted are not serious enough to affect the reactor operation. Fuel-plate recovery for 25,000 fuel plates has been 90%, with the largest losses occurring in blistered plates and surface damage. Author (NSA)

N68-33355# Battelle Memorial Inst., Richland, Wash. Pacific Northwest Lab.
IN-REACTOR CREEP OF STRUCTURAL MATERIALS FOR NUCLEAR APPLICATIONS
E. R. Gilbert and N. E. Harding 28 Jun. 1968 34 p refs Presented at the ASTM Symp. on Effects of Radiation on Structural Metals, San Francisco, 26–28 Jun. 1968
(Contract AT(45-1)-1830)
(BNWL-SA-1458; CONF-680604-5) CFSTI: HC $3.00/MF $0.65

Neutron irradiation can cause the creep rate of a material to increase, decrease, or to remain unchanged. Each of these possible results has been observed in creep during neutron irradiation. In hcp alloys increased creep rates have been observed both in Zircaloy-2 and Zr–2.5 Nb at creep rates below 10^{-10} sec^{-1} at 300°C. At temperatures above 350°C in-reactor creep rates of Zr–2.5 Nb are not different than those of unirradiated control tests, whereas in Zircaloy-2 the creep rate may increase, decrease, or remain the same upon reactor shutdown depending on the stress and temperature. Stress relaxation tests reported for zirconium alloys below 100°C resulted in more relaxation during neutron irradiation inferring faster creep rates. In-reactor creep tests for fcc alloys type 304 stainless steel and Hastelloy X-280 at temperatures above 500°C have resulted in little if any difference in creep rate, although the range of second stage creep was significantly reduced. Author (NSA)

N68-33369# Los Alamos Scientific Lab., N. Mex.
USE OF AN ON-LINE COMPUTER IN THE TESTING OF PROTOTYPE NUCLEAR ROCKET ENGINES
J. B. Henshall, E. P. Elkins, and W. F. Carlson 1968 5 p Presented at AIAA 4th Propulsion Specialist Conf., Cleveland
(Contract W-7405-ENG-36)
(LA-DC-9460; CONF-680609-3) CFSTI: HC $3.00/MF $0.65

A process computer has been incorporated in the testing of prototype nuclear rocket engines. The type of testing which led to the need for a computer is reviewed, and the testing philosophy which gave rise to its applications is discussed. The basic computer

has a 16-bit word core memory with analog and binary input and output capability, a disc storage unit, magnetic tape input-output and two CRT displays. An executive system is employed to monitor various requests for data and assign computing priorities to assure that data and control functions are generated in the correct sequence. The computer is used to generate the run profiles which control the demanded values of various reactor and facility parameters during testing. Ten profiles are generated simultaneously by approximating the desired curve by a series of small steps which are suitably smoothed to satisfy control requirements. Author (NSA)

N68-33386# Atomic Energy Establishment, Winfrith (England). Control and Instrumentation Div.

PARAMETER ESTIMATION FROM DRAGON HIGH TEMPERATURE GAS COOLED REACTOR DYNAMIC EXPERIMENTS

J. D. Cummins 1968 107 p refs

(AEEW-R-571; DPR-598) CFSTI: HC $3.00/MF $0.65

Dynamic experiments were performed on the Dragon high temperature gas cooled reactor at full power of 20 MW(t). Both terminated ramp and pseudo-random chain code perturbations were applied to a control rod for two amplitudes of reactivity perturbation. Neutron flux and thermocouple signals were observed and recorded, together with samples of the inherent noise with the reactor unperturbed. Frequency responses were deduced from the measurements and compared with previous sinusoidal frequency response measurements and theoretical predictions. A simplified model was constructed and optimized by least squares fitting of the equivalent response from the binary cross correlator to the model's output. These optimizations showed that a very simple feedback model is appropriate to Dragon and that a good estimate of the power/reactivity coefficient and temperature coefficient of reactivity may be made. Author (NSA)

N68-33425# Commissariat a l'Energie Atomique, Csdarache (France).

CALCULATION OF A FAST REACTOR CONTROL ROD IN MULTIGROUP DIFFUSION THEORY IMPROVED BY A METHOD OF THE TYPE AMOUYAL, BENOIST, AND HOROWITZ [CALCUL D'UNE BARRE DE CONTROLE DE REACTEUR RAPIDE EN THEORIE DE DIFFUSION MULTIGROUPE, AMELIOREE PAR UNE METHODE DU TYPE AMOUYAL, BENOIST ET HOROWITZ]

T. Lacapelle Dec. 1967 46 p refs In FRENCH; ENGLISH summary

(PNR/SETR-R-022)

It is shown that it is possible to adjust the diffusion coefficients of a homogeneous absorbing rod, in order to get, in a cell geometry multigroup diffusion theory calculation, essentially the same number of captures, hence the same antireactivity, as in a multigroup transport calculation. For each energy group, a thermal utilization factor type problem is considered, and the diffusion coefficient of the rod, D_u, is adjusted with respect to the ratio Φ_m/Φ_u of the average flux in the outside medium (m) to the average flux in the rod (u). Taking the asymptotic part of Φ_m, D_u is adjusted with respect to the ratio of the asymptotic flux at the rod surface to the average flux in the rod. This ratio is determined a priori, for each group independently, using the classical Amouyal, Benoist and Horowitz method. A numerical comparison for six different control rods is given. Author (NSA)

N68-33428# Battelle-Northwest, Richland, Wash. Dept. of Reactor Physics.

PCTR INTEGRAL MEASUREMENTS OF PLUTONIUM 239 CAPTURE-TO-FISSION CROSS SECTION RATIO IN FAST SPECTRA

D. D. Lanning, G. J. Busselman, C. L. Bennett, D. F. Newman, and S. R. Bierman 15 Apr. 1968 42 p refs

(Contract AT(45-1)-1830)

(BNWL-774) CFSTI: HC $3.00/MF $0.65

An analysis of the feasibility of integral measurements of $\bar{\alpha}$ for ^{239}Pu in the Physical Constants Test Reactor (PCTR) as a function of the carbon-to-uranium ratio in plutonium oxide-uranium oxide-carbon mixtures is summarized. The experiments proposed will use 8 to 14% PuO_2 (of low ^{240}Pu) in UO_2 mixed with graphite. It is concluded that integral values of $\bar{\alpha}$ for ^{239}Pu can be measured in the PCTR with an uncertainty less than ±0.06. NSA

N68-33429# Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.

THE EFFECT OF COLD WORK, THERMAL TREATMENT, AND NEUTRON IRRADIATION ON THE FRACTURE TOUGHNESS OF ZIRCALOY 2

R. G. Rowe and R. G. Hoagland 26 Apr. 1968 25 p refs Presented at the ASTM Symp. on Effects of Radiation on Structural Metals, San Francisco, 26–28 Jun. 1968

(Contract AT(45-1)-1830)

(BNWL-SA-1805; CONF-680604-4) CFSTI: HC $3.00/MF $0.65

The temperature dependence of fracture behavior of Zircaloy-2, as affected by cold working, hot water environment, and neutron irradiation is discussed. NSA

N68-33430# Battelle-Northwest, Richalnd, Wash. Pacific Northwest Lab.

PARAMETERS WHICH INFLUENCE THE IN-REACTOR CORROSION OF ZIRCONIUM ALLOYS

A. B. Johnson, Jr. 2 May 1968 14 p refs Presented at the AEC Corrosion Symp., Columbus, Ohio, 6–8 May 1968

(Contract AT(45-1)-1830)

(BNWL-SA-1719; CONF-680510-1) CFSTI: HC $3.00/MF $0.65

Results of tests to determine variables affecting radioinduced corrosion of Zr alloys are presented. Effects of coolant composition, alloy composition, and pretreatment procedures are emphasized. The data were obtained on samples exposed in ETR and PRTR. NSA

N68-33431# General Electric Co., Schenectady, N. Y. Knolls Atomic Power Lab.

LWB/LSBR DEVELOPMENT PROGRAM: SOME INPUT PROPERTIES FOR COMPUTER DESCRIPTION OF FUEL PROPERTIES

W. K. Anderson and G. L. Lechliter Jun. 1967 18 p refs

(Contract W-31-109-ENG-52)

(KAPL-3300) CFSTI: HC $3.00/MF $0.65

Use of analytic functions to input various physical properties of materials in a computer routine is discussed. Among these are thermal properties, equations for gap or contact conductance, thermal conductivity of fuel, and thermal conductivity of Zircaloy-2 cladding material. Discussions of mechanical properties, computational schemes for fuel viscosity, Young's modulus for Zircaloy and for fuel, and coefficient of thermal expansion for fuel are included. Comparisons of computed values with experimental data are shown in several curves. Author (NSA)

N68-33433# Battelle Memorial Inst., Richland, Wash. Pacific Northwest Lab.

THEORY OF CORROSION PRODUCT GENERATION, DISPERSION, AND ACTIVATION PROCESSES

J. W. Bartlett May 1968 100 p refs

(Contract AT(45-1)-1830)

(BNWL-676) CFSTI: HC $3.00/MF $0.65

A theoretical discussion of transport phenomena for corrosion products in water cooled nuclear reactors is presented. Processes and mechanisms of corrosion product transport are defined, and a system of equations to describe corrosion product mass and activity dispersion is developed. Theoretical and experimental work required to advance understanding is described. Author (NSA)

N68-33490# Atomics International, Canoga Park, Calif.
LARGE RADIOISOTOPE HEAT SOURCE CAPSULE PROGRAM. TOPICAL REPORT NO. 3: CERAMIC COATING PROCESS DEVELOPMENT AND EVALUATIONS
A. K. Smalley 15 Mar. 1968 60 p refs
(Contract AT(29-2)-2338)
(AI-AEC-12643) CFSTI: HC $3.00/MF $0.65

Aluminum oxide coatings from 0.5 to about 3 mils thick were deposited on T-111 test specimens measuring 0.37" in diameter and 1" long by a chemical vapor deposition (CVD) process. Coating temperatures ranged from 1750° F to 2200° F; the best coatings were deposited at 1950° F. The X-ray diffraction analyses show the coatings to consist predominantly of well-crystallized α Al_2O_3. Metallographic examinations show the Al_2O_3 to be dense and adherent to the T-111 substrate. Microhardness indentations made in the T-111 immediately adjacent to the Al_2O_3 suggest some superficial contamination by a hardening impurity. The hardened zone usually extended only 4 or 5 mils into the substrate. Bulk chemical analyses show that all specimens were contaminated slightly with C, N_2, and H_2 during processing. The measured levels of these impurities are considered acceptable. A 0.5 mil flash of tungsten, applied by CVD to the T-111 prior to coating with Al_2O_3, was not shown conclusively to prevent hardening of the T-111 during Al_2O_3 deposition. A few experiments to apply Al_2O_3 coatings by arc plasma spraying and sputtering did not produce coatings to meet the postulated requirements. Author

N68-33493# Atomics International, Canoga Park, Calif.
PNPF RECOVERY CORE LOWER GRID PLATE TEMPERATURES
H. Moore 16 Jan. 1968 22 p refs
(AI-AEC-Memo-12574) CFSTI: HC $3.00/MF $0.65

Alternate configurations of element lower end fittings are considered in the determination of clearances and leakage flows through holes in the lower grid plate. Gamma heating rates in the lower grid plate for a 41-element core operating at 30 Mw are calculated. Heat transfer coefficients are derived. Axial temperature profiles at an adiabatic locus in the hottest region of the plate are determined for each configuration. For an end fitting of 4.358 in. diameter two limiting cases are considered. With zero clearance (a plugged hole), the maximum differential temperature is found to be 51°F, producing a deflection of the lower grid plate conservatively calculated not to exceed 25 mils and no outlet thermocouple error due to mixing. With a diametral clearance of 0.020 in., resulting from maximum tolerances, the temperature gradient is found to be 15°F, producing a plate deflection of approximately 7 mils and an outlet thermocouple error due to coolant mixing of about 1°F at 100% element flow. It is concluded that this configuration is acceptable from thermal and hydraulic considerations and that no thermocouple shroud will be required to reduce mixing errors. Author (NSA)

23 PHYSICS, GENERAL

Includes acoustics, cryogenics, mechanics, and optics. For astrophysics see: 30 Space Sciences. For geophysics and related information see also: 13 Geophysics; 20 Meteorology; and 29 Space Radiation.

N68-32371# Naval Ordnance Lab., White Oak, Md.
MOVING BOUNDARY CONDITIONS IN AN ELASTIC MEDIUM
Louis F. Libelo and Bernard Brown 10 Jan. 1968 18 p refs
(NOLTR-68-92; AD-671868)

The well known acoustic boundary value problem is extended to include situations where the boundary translates at constant velocity. Solution of the wave equation, in three dimensions, for a disturbance in a homogeneous, linear, irrotational elastic medium has been effected in the presence of a translating boundary. A study was made of the effect of this motion on the normal modes and standing wave patterns of the system. Author (TAB)

N68-32375 Oregon Univ., Eugene.
MAGNETIC SUSCEPTIBILITY FOR A MAGNETIC BREAKDOWN MODEL
John Ruvalds (Ph.D. Thesis) 1967 89 p
Available from Univ. Microfilms: HC $4.60/MF $3.00 Order No. 67-16181

The rigorous magnetic susceptibility is calculated as a function of the magnetic field for a model Hamiltonian which exhibits the phenomena of magnetic breakdown. The Hamiltonian is based on the $k \cdot p$ perturbation method and hence is not restricted to the free-electron approximation. The electron trajectories in k-space corresponding to this model are two closed orbits: for low magnetic fields one is within the other; for high fields they are two intersecting elliptical orbits. Exact eigensolutions are obtained by reducing the Schrödinger equation to a pair of coupled difference equations and solving the resulting equations numerically. Magnetic energy levels are calculated as a function of the energy gap and are found to evolve from degenerate equally spaced levels for very small gaps to levels with different spacings determined by the zero-field orbits for larger gaps. The magnetic susceptibility is obtained by numerically evaluating the derivative of the Helmholtz free energy using the exact eigenvalues of the model Hamiltonian, and dividing the result by the magnetic field. Dissert. Abstr.

N68-32449 Texas Univ., Austin.
LOW TEMPERATURE RESISTIVITY AND MAGNETORESISTANCE OF METAL-AMMONIA COMPOUNDS
Robert Claiborne Cate (Ph.D. Thesis) 1967 78 p
Available from Univ. Microfilms: HC $4.20/MF $3.00 Order No. 67-14811

Electrical resistivity and magnetoresistance measurements were made with an electrodeless ac technique on cylindrical samples of tetraamine lithium and 16% and 25% cesium-ammonia solutions at liquid helium temperatures. The effect of different methods of freezing on these electrical properties was also studied. The resistivity of tetraamine lithium shows a T^2 temperature dependence, due to thermal scattering, from 4.2°K to 1.5°K, and reaches a temperature independent value of 0.1–0.4 $\mu\Omega$cm only below 2°K. The 16% cesium–ammonia solution exhibits a temperature independent resistivity of 17.5 $\mu\Omega$cm below 4.2°K, while the 25% solution shows a T^2-dependent resistivity down to 1.5°K, where it attains a residual resistivity of about 2.9 $\mu\Omega$cm. No variation in magnetoresistance with angle of the magnetic field is observed; this is considered evidence of the polycrystalline nature of the solid. Neither of the cesium-ammonia compounds exhibits a detectable magnetoresistance at helium temperatures. Dissert. Abstr.

N68-32457 National Lending Library for Science and Technology, Boston Spa (England).
MEASUREMENT OF AEROSOL PARTICLE SIZE RANGES BY MEANS OF CENTRIFUGAL SEPARATORS [ZUR MESSUNG VON AEROSOL-TEILCHENGROESSENSPEKTREN MIT HILFE VON ZENTRIFUGALABSCHEIDERN]

W. Stoeber and U. Zessack 18 Sep. 1967 20 p refs Transl. into ENGLISH from Zentr. Biol. Aerosol Forsch. (Stuttgart), v. 13, no. 3/4, 1966 p 263–281
(SMRE-TRANS-5432) Available from Natl. Lending Library, Boston Spa, Engl.

The basis of particle size spectrometry of particles suspended in air is discussed by critically examining the sedimentation properties of particles in the field of gravitation. Two analytical methods are distinguished: the elutriator principle and the spectrometer principle. With the former, a kind of cumulative particle size precipitation is obtained from which the size distribution of the kinetic particle diameters can be calculated. With the latter, the particles are separated directly in space in accordance with their kinetic diameters and the size distribution can be determined directly by experiments. Both principles have been used in the design of centrifugal separators for the determination of aerosol size spectra. Centrifuges operating on the elutriator principle present the difficulty that the particle precipitation can be calculated only approximately for a certain particle range. Only true centrifugal spectrometers permit an exact determination of the particle size range. For this purpose, an approximate solution for the calculation of the particle trajectories and of their terminal points on the separation foil is proposed for the first time. Author

N68-32468 National Lending Library for Science and Technology, Boston Spa (England).
THE TRANSFORMATIONS OF INFORMATION IN OPTICS [LES TRANSFORMATIONS DE L'INFORMATION EN OPTIQUE]
D. Gabor 6 Jun. 1968 22 p refs Transl. into ENGLISH from Opt. Acta (London), v. 13, no. 4, 1966 p 299–310 In FRENCH and ENGLISH
(EE-TRANS-1785) Available from Natl. Lending Library, Boston Spa, Engl.

According to Huygens' principle, all the planes of an optical instrument contain the same information, but in a form that is more or less decipherable. To decipher the N invariant data in a given almost monochromatic illumination, it is necessary to perform $2N^2$ measurements. With a coherent illumination, only 2N measurements are required; N amplitudes and N phases, which can be recorded on a single photographic plate, by the simple artifice of adding a coherent background to it. Such a photograph or "hologram" contains the original wave front in a "frozen" condition in the emulsion. To "revive" it, one just has to illuminate the plate with the coherent background or "reference beam". The author discovered this principle in 1948 and holography later experienced a brilliant revival after the invention of the laser. Holograms of old and recent reconstitutions are presented, together with the discussion of variations and a few applications. Author

N68-32503 National Lending Library for Science and Technology, Boston Spa (England).
MATERIALS, TECHNOLOGY AND ECONOMICS OF PRODUCTION [VOZMOZHNOSTI POVYSHENIYA TOCHNOSTI BALANSIROVKI GIBKIKH ROTOROV
N. G. Samarov Jul. 1968 13 p refs Transl. into ENGLISH from Energomashinostr. (Moscow), v. 14, no. 1, 1968 p 29–33
(RTS-4630) Available from Natl. Lending Library, Boston Spa, Engl. 12s 6d

Performed are frequency-amplitude calculations for a flexible rotor when the unbalance is concentrated in a transverse plane passing through the rotor's center of gravity. It is shown that all rotor elements need individual balancing in order to avoid vibration and to eliminate flexible deflections of the axis. The share of unbalance of resilient elements in the total sum of dynamic deflection increased the nearer the r.p.m. was to critical speed. G.G.

N68-32624 National Lending Library for Science and Technology, Boston Spa (England).
STUDY OF THE CHARACTERISTIC K ABSORPTION OF X-RAYS AT THE TEMPERATURE OF LIQUID OXYGEN [VIVCHENIYA KHARAKTERISICHNOGO K-POGLINANIYA RENTGENIVS'KIKH PROMENIV PRI TEMPERATURI RIDKOGO KISNYU]
S. M. Karal'chik and V. P. Krivits'kii Nov. 1967 7 p refs Transl. into ENGLISH from Ukr. Fiz. Zh. (Kiev), v. 8, no. 6, 1963 p 690–693
(RTS-4219) Available fron Natl. Lending Library, Boston Spa, Engl.: 10s

The K absorption of X-rays was studied for copper, iron, manganese, and other elements at temperatures of approximately −180°C through the use of a simple cryostat with copper and silver nickel tubing and vacuum sealing. Specimen temperature was measured by a copper thermocouple introduced in the middle of the cryostat. Results indicated that the K edges of iron and copper do not alter their position on the wavelength scale. Measurements made of iron oxide in combination with chromium, cobalt, manganese, nickel, vanadium, and zinc also exhibited practically no variation. These results confirm previous data that over a very wide range of temperatures substances in the solid state do not show changes in the electronic structure of their atoms. M.W.R.

N68-32625 National Lending Library for Science and Technology, Boston Spa (England).
A STUDY OF THE MAGNETIC FIELD OF A CIRCULAR LOOP BY MEANS OF THE SCALAR MAGNETIC POTENTIAL [ISSLEDOVANIE MAGNITNOVO POLYA KRUGOVOVO KONTURA S POMOSHCHYU SKALARNOVO MAGNITNOVO POTENTSIALA]
B. V. Frolov Oct. 1967 10 p Transl. into ENGLISH from Izv. Vysshikh Uchebn. Zavedenii, Elektromekhan. (Novocherkassk), no. 9, 1966 p 919–926
(RTS-4196) Available from Natl. Lending Library, Boston Spa, Engl.: £1

Determination of scalar magnetic potential of a current-carrying loop permits the plotting of equipotential lines as well as the determination of the field intensity vector and its components at any point. Examples of the potential and the lines are graphed, as is magnetic induction at different points of the field of a circular loop. Based on the angle which the magnetic induction vector makes with the plane of the circuit is plotted on the coordinates of the field points; and the fundamental characteristics of a circular loop field are tabulated. M.W.R.

N68-32636# Grumman Aircraft Engineering Corp., Bethpage, N. Y.
HIGH-RESOLUTION SPECTRAL ANALYSIS WITH COHERENT OPTICS
B. J. Pernick, D. Yustein, and C. Bartolotta Aug. 1968 17 p refs
(FSN-AD3-06-68.1)

A coherent optical system with an extremely large time-bandwidth product (of the order of 10^6) has been recently discussed in the literature. Such high frequency-resolution systems are of current interest and importance as power spectral density analyzers. A mathematical model of this optical computer is first discussed. From this it is shown that aspherical optics can be used to simplify a difficult readout problem due to the high input data content of the optical system. Experimental tests to illustrate system performance have been made. Author

N68-32658 National Lending Library for Science and Technology, Boston Spa (England).
A STUDY OF THE CONTROL OF TIN CONTENT IN MINERAL RAW MATERIALS BY THE RESONANCE ABSORPTION OF GAMMA RAYS (MOSSBAUER EFFECT)

[ISSLEDOVANIE METODA KONTROLYA SODERZHANIYA OLOVA V MINERAL'NOM CYR'E PO REZONANONOMU POGLOSHENIYU GAMMA-LUCHEI (EFFEKT MOESSBAUERA)]

N. N. Shumilovskiim, N. Salakhutdinov, and A. A. Kalmakov Nov. 1967 15 p refs Transl. into ENGLISH from Izv. Akad. Nauk Uz. SSR, Ser. Tekhn. Nauk (Tashkent), no. 5, 1964 p 29–37 (RTS-4180) Available from Natl. Lending Library, Boston Spa, Engl.: £17s 6d

The application of the Mossbauer effect to the automatic control of the composition of complex mixtures is investigated. The results show the possibilities of controlling the tin content in ores and their enrichment products by the resonance absorption of gamma rays. The results also show that to control the tin content with an accuracy sufficient for chemical analysis it is essential to choose a definite value of the density/thickness factor. The gamma ray resonance absorption method is more sensitive at low tin concentrations. It differs from other radioactive methods in that the presence of other elements in the specimens does not produce errors in the measurements. The results reported will help to solve the problem of the principle to be used in designing of automatic instruments for controlling the tin content in tin ores and their enrichment products. Author

N68-32667 National Lending Library for Science and Technology, Boston Spa (England).

INTERFEROMATIC METHOD FOR DETERMINATION OF REFRACTIVE INDEX OF MICA

I. N. Shklyarevskii, T. I. Korneeva, and A. N. Ryazanov Jan. 1968 6 p refs Transl. into ENGLISH from Zh. Prikl. Spektroskopii, Akad. Nauk Belorussk. SSR (Minsk), v. 4, no. 1, 1966 p 65-67 (RTS-4197) Available from Natl. Lending Library, Boston Spa, Engl.: 7s 6d

A method for the interferometric determination of the birefringent dispersion of the refractive indices μ_γ and μ_β of mica in the visible region of the spectrum is described. It is shown that it is possible to select from a small number of laminae of mica some whose thickness varies discontinuously by an amount $t = t_1 - t_2$ and that two systems of doublet lines occur with these laminae corresponding to the thicknesses t_1 and t_2. It was found that: (1) when lines of equal chromatic order are photographed with a prism spectrograph the intensities of the γ and β components differ because of polarization in the spectrograph, and that this difficulty can be readily eliminated by rotating a Polaroid screen placed in front of the slit of the spectrograph; (2) the thickness $t = t_1 - t_2$ can be measured by a graphic interference method which eliminates the effect of the phase change arising on reflection at the air-silver interface; and (3) having determined the wave lengths corresponding to the thicknesses t_1 and t_2 for lines of equal chromatic order, and their interference orders, curves can be plotted which enable the refractive indices μ_γ and μ_β to be determined. S.C.W.

N68-32697# Polytechnic Inst. of Brooklyn, Farmingdale, N. Y. Dept. of Electrophysics.

APPLICATION OF ELECTROMAGNETIC THEORY TO RADIATING AND NON-RADIATING TRANSMISSION LINES

Final Report, 1 Dec. 1964–30 Nov. 1967

Arthur A. Oliner 1 May 1968 48 p refs (Contract AF 19(628)-4324) (PIBEP-68-011; AFCRL-68-0262; AD-671975

This report consists of a summary of accomplishments over the past three years. Only a brief resume of the topics covered is presented; detailed descriptions are contained in reports and publications which are referenced in context with these resumes. The investigations are concerned with the guiding, scattering and radiating properties of a variety of structures, particularly those with periodic properties. The wave types have been primarily electromagnetic, although a later phase has included acoustic waves as well. The studies themselves are basic in character, with emphasis on thorough treatments; the motivation for the topics chosen has in all cases been their importance and usefulness in various applications. Among the topics treated in detail are: leaky waves and surface waves, Cerenkov radiation, Smith-Purcell radiation, effects of glide and screw symmetry in periodic structures, radiation from corrugated surfaces, Woods anomalies in scattering theory, Bragg scattering from acoustically-modulated regions, and parametric interactions in nonlinear optics and acoustically-modulated media, including the effects of boundaries. Author (TAB)

N68-32701 Polytechnic Inst. of Brooklyn, N. Y.

GUIDING AND SCATTERING OF ELECTROMAGNETIC FIELDS BY CORRUGATED STRUCTURES

David Yuin-chi Tseng (Ph.D. Thesis) 1967 216 p Available from Univ. Microfilms: HC $9.90/MF $3.00 Order No. 67-13425

This study deals with an analysis of the guiding and plane wave scattering of electromagnetic fields by planar corrugated structures. Attention is focused primarily on the multi-mode aspects of the problem in order that the guiding properties in the leaky (complex) wave region and the scattering behavior associated with Wood anomalies of the S and P polarizations (i.e., TM and TE modes) may be examined. The major portion of this work is devoted to the uniform planar corrugated structure, for which the TM and TE polarizations are analyzed in detail. Explicit expressions for the dispersion relation and reflection coefficients--valid for the various multi-mode cases considered (viz., up to two propagating modes in each of the air and plate regions)--are derived for the above polarizations. Numerical solutions of the propagation characteristics and reflection coefficients are presented for each case considered. Analytic solutions for the more general N-depths corrugated structure (i.e., one which contains N arbitrary corrugation depths in a single period) are obtained, also Dissert. Abstr.

N68-32743# California Univ., Berkeley. Dept. of Physics.

NUCLEAR MAGNETIC RESONANCE IN LIQUID INDIUM AND BISMUTH

Frederick A. Rossini (Ph.D. Thesis) May 1968 42 p refs (Contract Nonr-3656(05)) (TR-10; AD-671815)

Data are presented for the nuclear spin-lattice relaxation time, T1, and the Knight shift, K, as functions of temperature in liquid Bi209. These data together with previously reported data for Ga69,71, Rb85,87, Sb121,123, Na23 and In115 are used to develop a broad interpretation of the nuclear spin-lattice relaxation rate, R1, in liquid non-transition metals. K is interpreted in connection with the analysis of R1. TAB

N68-32775# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

SHIELDING AN EXTERNAL FIELD BY A HOLLOW OBLATE ELLIPSOID [EKRANIROVANIYE VNESHNEGO POLYA POLYM SPLYUSHUTYM ELLIPSOIDOM]

S. I. Kurenev and M. G. Volkov 29 Aug. 1967 9 p refs Transl. into ENGLISH from Izv. Vyssh. Ucheb. Zaved., Elektromekhan. (Novocherkassk), no. 9, 1963 p 1027–1031 (FTD-HT-23-820-67; AD-671731)

For practical purposes, such as investigating the effect of foreign bodies on the electric strength of dielectrics, a boundary problem is approximately solved by using the Laplace equation. Those cases where the external field is oriented along the x-axis and along the z-axis are considered. Long theoretical formulas for the shielding factor are given, as well as curves showing the effects of the dielectric constant upon the shielding factor. In dealing with ellipsoid shields, taking the direction of the field into account is recommended. TAB

N68-32990 Electrotechnical Lab., Tokyo (Japan).
PHOTOELECTRON COUNTING AND ITS APPLICATIONS
Motoi Nanjo Jan. 1968 80 p refs In JAPANESE and ENGLISH
Its Circ. No. 162
CFSTI: HC $3.00/MF $0.65

Both the quantities and the qualities of light which we utilize are now increasing. Since the photon is the elemental unit of light, counting the number of incident individual photons is thought to be the most fundamental and the most sensitive method of light measurements. The idea of this counting light quanta is an old one, but the practical achievement of this with ease, is in debt to the progresses of various fields such as the producing techniques of the phototubes containing the high vacuum engineering, evaporation techniques of thin film of active materials, electronic engineering and mostly to the development of scintillation analysis in the use of atomic energy. In our section of light measurements, a group for developing photon counting method has been organized, since 1964. This report intends to give the general survey of photon counting and other new techniques in the field of light measurements and comparisons between them, basing on the papers collected by our group and on our experiments on photometric characteristics. Author

N68-32999# Academy of Sciences (USSR), Moscow. Inst. of Atomic Energy.
EXPERIMENTAL RESEARCH INTO THE KINETICS OF AIR SORPTION IN NITROGEN-COOLED ULTRAHIGH VACUUM SORPTION PUMPS [EKSPERIMENTAL'NYE ISSLEDOVANIYA KINETIKI SOROTSII VOZDUKHA V SOROTSIONNYKH SVERKHVYSOKOVAKUUMNYKH NASOSAKH S AZOTNYM OKHLAZHDENIEM]
A. V. Aref'ev and S. P. Maksimov 1967 32 p refs In RUSSIAN
(IAE-1300)

Experimental research into the kinetics of air sorption in nitrogen-cooled sorption pumps is described. The rates of air sorption for various sorbents at liquid nitrogen temperature and at various pressures are determined. It is shown that the rate of the sorption of air by various sorbents at low pressures is not a constant but decreases with increase in the amount of the sorbed air or gas. The effect of the cylindrical pump cavity on the rate of evacuation of air by sorbents is investigated and the optimal parameters of the cavity are determined. Author (NSA)

N68-33106 European Organization for Nuclear Research, Geneva (Switzerland).
BEAM STACKING WITH SUPPRESSED BUCKETS IN THE ISR
A. G. Ruggiero 4 Jun. 1968 40 p refs
(CERN-68-22)

The process of accumulating a beam in the CERN intersecting storage rings (ISR) by radio-frequency stacking with suppressed buckets at $I' = 0.50$ and at $I' = 0.84$ was investigated on a computer. The stacking efficiency was calculated for several values of the number of the suppressed buckets. The results show that within the statistical error, the stacking efficiency does not depend on the number of suppressed buckets provided one always injects such a number of pulses that the total numbers of stacked buckets are equal. Author

N68-33134# Brookhaven National Lab., Upton, N. Y.
MOLECULAR FIELD CALCULATION
T. A. Kitchens 6 May 1968 15 p Sponsored by AEC
(BNL-12468) CFSTI: HC $3.00/MF $0.65

A Fortran IV program to compute the magnetization of a Molecular Field Ferromagnet in an applied field is presented. Example cases are tabulated and graphed. Author (NSA)

N68-33157# California Inst. of Tech., Pasadena. Antenna Lab.
THE RESOLUTION OF THE THERMODYNAMIC PARADOX AND THE THEORY OF GUIDED WAVE PROPAGATION IN ANISOTROPIC MEDIA
Adolph V. Mrstik, Jr. Jun. 1968 161 p refs
(Grant AF-AFOSR-1400-68)
(TR-46; AFOSR-68-1193; AD-671960)

The resolution of the so-called thermodynamic paradox is presented in this paper. It is shown, in direct contradiction to the results of several previously published papers, that the cutoff modes (evanescent modes having complex propagation constants) can carry power in a waveguide containing ferrite. The errors in all previous proofs which purport to show that the cutoff modes cannot carry power are uncovered. The boundary value problem underlying the paradox is studied in detail; it is shown that, although the solution is somewhat complicated, there is nothing paradoxical about it. The general problem of electromagnetic wave propagation through rectangular guides filled inhomogeneously in cross-section with transversely magnetized ferrite is also studied. The problem is split into TE and TM parts and scalarized. Application of the standard waveguide techniques reduces the TM part to the well-known self-adjoint Sturm Liouville eigenvalue equation. The TE part, however, leads in general to a non-self-adjoint eigenvalue equation. This equation and the associated expansion problem are studied in detail. Expansion coefficients and actual fields are determined for a particular problem. Author (TAB)

N68-33200# Akademiya Nauk USSR, Kiev. Inst. Teoreticheskoi Fiziki.
SPECTRAL REPRESENTATION OF AMPLITUDE-LIKE QUANTITIES
V. G. Pisarenko 1968 36 p refs
(ITF-68-1)

A spectral representation is obtained for the vacuum expectation of the causality commutators of two divergences of the axial current. Some properties of spectral density following from the PCAC hypothesis are considered. Author (NSA)

N68-33250# Polish Academy of Sciences, Warsaw.
BEAM MATCHING BETWEEN 510 KEV PROTON INJECTOR AND 10 MEV LINEAR STRONG FOCUSING ACCELERATOR [DOPASOWANIE WIAZKI PROTONOW INJECTORA 510 KEV DO LINIOWEGO AKCELERATORA PROTONOW 10 MEV Z SILNYM OGNISKOWANIEM]
E. Dziura 1967 26 p refs
(Rept.-875/SLBAL/PL) CFSTI: $3.00

Optical parameters of the beam matching system between 510 keV proton injector and 10 MeV linac were determined. Taking into consideration the properties of the optical channel of the linac (strong focusing system), two magnetic triplets arrangement allowing precise matching of the source emittance to the acceptance of the linac was chosen. A range of lens magnetic gradients as a function of focal strengths was computed and illustrated graphically. Author

N68-33261# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
NEWS OF INSTITUTIONS OF HIGHER LEARNING. AERONAUTICAL ENGINEERING, NO. 1, 1966 (SELECTED ARTICLES)
2 Oct. 1967 47 p refs Transl into ENGLISH from Izv. Vysshikh Uchebn. Zavedenii, Aviats. Tekhn. (Kazan), no. 1, 1966 p 73–79, 90–99, 123–129, 146–155
(FTD-MT-24-131-67; AD-670069)

Contents: Stability and natural vibrations of truncated structurally-orthotropic conical shells; Pressures in sealing grooves of hydraulic assemblies; Convection heat exchange in a closed space between two rotating disks under turbulent flow conditions; Separation flow around a vibrating profile. TAB

N68-33317# Michigan Univ., Ann Arbor.
POLARIZABILITY MEASUREMENTS OF THE ALKALI ATOMS SODIUM, POTASSIUM, RUBIDIUM, AND CESIUM
William Davis Hall (Ph.D. Thesis) 1967 155 p refs
(Contract AT(11-1)-1112)
(COO-1112-164) CFSTI: HC $3.00/MF $0.65

This study reports on the experimental determination of the electric dipole polarizabilities of the alkali-metal atoms sodium, potassium, rubidium, and cesium. The measurements were made by observing the deflections of a collimated, velocity-selected atomic beam under the influence of an unhomogeneous electric field. The polarizabilities measured in this experiment were found to differ from previous experimental polarizability determinations in which beam velocity analysis was not available. Subsequent experiments measuring velocity profiles and polarizabilities as a function of argon scattering gas densities have demonstrated that the discrepancy in the polarizability values arises because of the velocity-dependent scattering effect of the residual gas atoms which selectively removes low-velocity atoms from the beam, thus distorting the assumed ideal modified Maxwellian velocity distribution. The polarizability values quoted here are in good agreement with recent polarizability predictions from alkali-metal atom lifetime measurements, oscillator strength measurements, and the theoretical predictions of Sternheimer and Stone. Author (NSA)

N68-33421 Missouri Univ., Columbia.
A STUDY OF THE THERMAL ACCOMMODATION OF THE NOBLE GASES ON BARE SURFACES OF LITHIUM AND POTASSIUM
James Edward Delmore, Jr. (Ph.D. Thesis) 1967 91 p
Available from Univ. Microfilms: HC $4.80/MF $3.00 Order No. 67-13847

The accommodation coefficients (A.C.'s) of helium, neon, argon, krypton, and xenon were measured on bare surfaces of lithium and potassium at several temperatures, ranging from 78°K to 273°K. The experimental results for helium, neon, and argon on a clean potassium surface are in good agreement with those previously obtained by Petersen in a hydrogen contaminated system. The present work, considered in the light of other recent work on alkali metal systems, therefore, supports the conclusion that Petersen's A.C. measurements were indeed on a clean surface of potassium. In view of the results on potassium and in consideration of the physical and chemical similarity of sodium and potassium, it is suggested that Petersen's A.C. values on sodium are also representative of a clean surface. Dissert Abstr.

N68-33445*# Kaman Aircraft Corp., Colorado Springs, Colo.
COMPARISON OF TWO METHODS FOR ESTIMATING SOUND INTENSITY
Jan. 1968 185 p
(Contract NAS8-11348)
(NASA-CR-61187) CFSTI: HC $3.00/MF $0.65 CSCL 20A

The results are presented of an effort to determine the advantages and disadvantages of present sound ray tracing techniques and to investigate the possible replacement of these with more exact procedures. As an adjunct to this investigation, an analysis of sound pressure levels was begun. The gackground and theory are described and a computer program is given. A discussion of the results includes typical atmospheric conditions, along with analyses of these atmospheric situations, both by the present methods and by the methods as developed in this study. Numerous comparisons are made between the two methods, with sometimes startling results. Author

N68-33497 Alabama Univ., University.
QUALITATIVE SOLUTION BEHAVIOR ON A FINITE INTERVAL
Robert William Gunderson (Ph.D. Thesis) 1967 109 p
Available from Univ. Microfilms: HC $5.40/MF $3.00 Order No. 67-13238

For all its popularity, the method of Liapunov functions, employed in the qualitative theory of ordinary differential equations, has met with only limited success in the application to physical problems. This lack of success can be at least partially explained by noting that the behavior of physical systems can only be observed over some finite time interval. However, the stability and boundedness definitions are given relative to an infinite interval. Further, even in those cases for which the solution behavior described by those definitions is reasonably consistent with the technical requirements, it remains to determine a suitable Liapunov function and this is a very difficult task. The purpose of this dissertation is to present results which overcome some of these difficulties. Several theorems are presented which provide necessary and sufficient conditions for certain types of solution properties over a finite time interval. Dissert. Abstr.

N68-33562 Polytechnic Inst. of Brooklyn, N. Y.
TRANSITION RADIATION AND RELATED TRANSIENT PHENOMENA
Edward Ott (Ph.D. Thesis) 1967 243 p
Available from Univ. Microfilms: HC $11.05/MF $3.15 Order No. 67-13412

This study deals with several problems in the theory of transient electromagnetic wave propagation. The phenomenon of transition radiation in non-dispersive media is examined. When a moving charge crosses a medium discontinuity, a burst of energy is given off at the time of impact. This phenomenon is called transition radiation. Since the discovery of transition radiation in 1946 numerous theoretical and experimental investigations have appeared in the literature. It is clear that transition radiation is fundamentally a transient process. A similarity principle will be obtained for a certain class of transient diffraction problems in dispersive media. Using this similarity principle, exact closed form solutions will be obtained to several problems. For example, a solution will be obtained to the problem of a vertical impulsive magnetic dipole current element situated in vacuum above a certain dispersive dielectric half-space. As in the time harmonic case, the solution may be interpreted in terms of direct, reflected and lateral wave rays. Dissert. Abstr.

N68-33563 Howard Univ., Washington, D. C.
A GENERAL THEORY OF INTERFACIAL TENSION AND ITS APPLICATION TO ADSORPTION PHENOMENA
Donald James Cotton (Ph.D. Thesis) 1967 144 p
Available from Univ. Microfilms: HC $6.80/MF $3.00 Order No. 67-13558

Theories and resulting mathematical equations describing the interfacial tension of and the adsorption from a binary solution had been developed along parallel, but separate paths. There existed a need to develop a general theory, with consequential equations, which would describe the preceding properties of binary mixtures on the basis of known physical properties of the individual components. The well known Gibbs equation, the only relationship that has been developed to describe liquid phase adsorption, considered neither the individual properties of the components nor the sturcture of the surface region, but describes adsorption only in terms of the interfacial tension and the concentration of the solution. Other equations used to describe liquid phase adsorption are largely borrowed via analogy from equations developed for vapor phase adsorption. These equations have had limited success in predicting adsorption from binary solutions. Dissert. Abstr.

N68-33605 National Lending Library for Science and Technology, Boston Spa (England).
ESTIMATE OF THE LOSS OF REFRIGERANTS BY CRYOSTATS AND CRYOPUMPS

H. Wiechert and K. Keck. 23 Nov. 1967. 11 p refs Transl. into ENGLISH from Z. Angew. Phys. (W. Berlin) *Its* Transl. 2430
Available from Natl. Lending Library, Boston Spa, Engl.

A method is described, which, even from the planning stage of a cryostat or cryopump, allows an accurate estimate of the refrigerant consumption to be expected. The method also considers the heat exchange between the exhaust gas flow of the evaporating cryogenic liquid and the cold gas return tube. The theoretical calculations are used to construct a cryopump with very low helium consumption (18–20 cm ^{2}h). The dependance of the refrigerating agent losses on pressure in the vacuum chamber is calculated and compared with experimental values. Author

24 PHYSICS, ATOMIC, MOLECULAR, AND NUCLEAR

Includes atomic, molecular, and nuclear physics. For applications see: 22 Nuclear Engineering. For related information see also: 29 Space Radiation.

N68-32240 Washington Univ., Seattle.
AN INVESTIGATION OF TWO AND THREE NUCLEON CLUSTERING IN B^{11}, N^{15} AND F^{19} USING (α,Li) REACTIONS AT AN INCIDENT ENERGY OF 42 MeV
Paul Francis Mizera (Ph.D. Thesis) 1967 111 p
Available from Univ. Microfilms: HC $5.60/MF $3.00 Order No. 67-14198

(α,Li^7) and (α,Li^{7*} 0.478) reactions on B^{11}, N^{15}, and F^{19} leading to the ground states of Be^8, C^{12}, and O^{16} and to the first excited state of C^{12} have been performed using 42 MeV alpha particles. In addition, (α,Li^6) reactions on N^{15} and F^{19} leading to the ground states of C^{13} and O^{17} and to the first excited state of O^{17} were analyzed. These angular distributions were compared with distorted-wave Born approximation calculations using a one cluster pick-up mechanism and reasonable agreement was found. Certain approximations in the analysis are discussed and qualitative suggestions are made to correct some of the deficiencies arising from these approximations. Dissert. Abstr.

N68-32244 Catholic Univ. of America, Washington, D. C.
ACTIVATION ENERGIES OF ELEMENTARY REACTIONS
Ralf-Dieter Herbst Penzhorn (Ph.D. Thesis) 1967 108 p
Available from Univ. Microfilms: HC $5.40/MF $3.00 Order No. 67-15428

The rate of addition of thermal and exited hydrogen atoms to ethylene and deuterated ethylene was measured. This was done by competing the reaction H + HI with H + C_2H_4. Since the rate of the first of these reactions, which was used as a standard, was questionable, the competition of H + HI with H + I_2 was studied first. The hydrogen atoms were produced by photolysis of HI with 2537 Å light. Since these H atoms are hot they were moderated by the presence of a large excess of inert gas and the effect of I_2 on the rate of H_2 formation measured. HI was then photolysed in the presence of a large excess of inert gas and the effect of C_2H_4 on the rate of formation of H_2 studied. These experiments permitted a better understanding of the mechanism of the process and allowed the kinetic parameters for the reactions H + HI → H_2 + I, H + C_2H_4 → C_2H_5 to be measured relative to the well known rate of the reaction H + I_2 → HI + I. Dissert. Abstr.

N68-32246 Rice Univ., Houston, Tex.
THE Ca^{40} (p,p) Ca^{40} REACTION
Wiley Foster Rich (Ph.D. Thesis) 1967 127 p
Available from Univ. Microfilms: HC $6.20/MF $3.00 Order No. 67-13115

Studies of the elastic scattering of protons from Ca^{40} have been made in the range of proton energies from 5.0 to 12.6 MeV. The investigation has consisted of measurements of excitation functions at laboratory angles of 90, 125, 140, and 170 degrees with an experimental resolution (beam dispersion plus target thickness) of about 15 keV, and measurements of angular distributions at approximately 0.5 MeV intervals with an experimental resolution of about 50 keV. The excitation functions show evidence for many resonances, attributable chiefly to s-, p-, d-, and f-wave scattering for proton energies up to ≈8.5 MeV. Above this energy, there is a marked attenuation of the resonance amplitudes, and the resonance shapes are generally unrecognizable. The angular distributions have basically similar shapes throughout the energy interval, and are little influenced by the local resonance structure. Dissert. Abstr.

N68-32250# Florida State Univ., Tallahassee.
AN EXPERIMENTAL STUDY OF NUCLEAR MODELS. 1: DECAY SCHEMES AND NUCLEAR REACTIONS Progress Report, 1 Aug. 1967–31 Jul. 1968
Raymond K. Sheline 31 Jul. 1968 376 p refs
(Contract AT(40-1)-2434)
(ORO-2434-4) CFSTI: HC $3.00/MF $0.65

Some experimental investigations of nuclear level schemes and structure by nuclear reactions, in which the data were analyzed using the collective model or the shell model, are summarized together with some supporting theoretical studies. Progress in the preparation and spectroscopy of metal carbonyls is also outlined. The publications that resulted from this research are listed; the full text of several papers is included. NSA

N68-32253 Rochester Univ., N. Y.
A STUDY OF THE O^{16}(He^3,n)Ne^{18} REACTION BETWEEN 7.6 AND 10.0 MeV
John Alan Robbins (Ph.D. Thesis) 1967 229 p
Available from Univ. Microfilms: HC $10.35/MF $3.00 Order No. 67-13644

Excitation curves and angular distributions of neutrons from the O^{16}(He^3,n)Ne^{18} reaction leading to the ground state and first three excited states of Ne^{18} have been measured at several He^3 energies from 7.6 to 10 MeV by use of a neutron time-of-flight spectrometer. The ground state angular distributions, especially at higher energy, show excellent stripping patterns characterized by an L=0 orbital angular momentum transfer. Application of the plane wave double stripping theory of Newns to the ground state data reveals a systematic dependence of the interaction radius on incident energy. No satisfactory plane wave fits were obtained for excited state distributions. A zero-range distorted wave calculation which treats the transferred diproton as a structureless, zero-spin particle yields cross section shapes in excellent agreement with the measured ones for all states. Dissert. Abstr.

N68-32254 Columbia Univ., New York.
THE PRODUCTION OF TRITIUM FROM He^4 BOMBARDED BY HIGH-ENERGY PROTONS
Elliot Lebowitz (Ph.D. Thesis) 1967 86 p
Available from Univ. Microfilms: HC $4.60/MF $3.00 Order No. 67-15498

In this experiment the cross section for the reaction p + He^4 → T + 2N + nπ was measured at 2.2 BeV. A more accurate radiochemical system for measuring tritium produced in nuclear reactions was developed and used in this experiment. The results of this work are significant for the study of nuclear-reaction mechanisms and space science. Additional experiments employing this radiochemical system are suggested. Dissert. Abstr.

N68-32274 California Univ., Los Angeles.
EXPERIMENTAL STUDY OF SCATTERING IN ATOM SURFACE COLLISIONS WITH ATOM ENERGIES OF THE ORDER OF 1 eV
Jack A. Alcalay (Ph.D. Thesis) 1967 132 p
Available from Univ. Microfilms: HC $6.40/MF $3.00 Order No. 67-14329

Scattering of modulated Argon atomic beams (with energies of the order of 1 eV and hydrodynamic speed ratios of the order of 7) from cleaved mica and from vacuum-deposited silver on cleaved mica consistently showed a multilobular pattern on a polar flux diagram. The scattering distributions are believed to be the first measured for beams with energies between 1 and 10 eV. Parameters varied during the experiments were (a) surface temperature and (b) time from deposition. The observed quasi-specular lobe bear a close resemblance to the distribution observed by other investigators who have scattered thermal energy beams from various surfaces and behave in some respects as predicted by one simplified collision model. Analyses of the data indicate that the detected molecules may have consisted of both scattered Argon atoms and flash desorbed unknown species from the surface. This suggestion might be tested by mass-spectrometric differentiation of the scattered molecules. Dissert. Abstr.

N68-32281 Northwestern Univ., Evanston, Ill.
KAON RESONANCE PRODUCTION IN HIGH ENERGY K⁻p INTERACTIONS
Frank Laverne Schweingruber (Ph.D. Thesis) 1967 109 p
Available from Univ. Microfilms: HC $5.40/MF $3.00 Order No. 67-15335

Results obtained from a bubble chamber analysis of K⁻p interactions at incident K⁻ momenta of 4.1 and 5.5 GeV/c are presented. The $\bar{K}^0\pi^\pm$ N final states were studied extensively and the most prominent feature of these is the production of $K^*(890)$ and $K^*(1400)$ resonances. The $\bar{K}^0\pi^-\pi^0$ N final states were investigated to measure the decay of $K^*(1400)^+$ into $K^*(890)\pi$ and $K\rho$. The experimental details are discussed, including descriptions of the high momentum separated beam to the 30" hydrogen bubble chamber and the data processing system used for this analysis. Evidence for quasi two-body production of $K^*(890)^-$, $K^*(1400)^-$ and $K^*(1800)^-$ is presented from the two-prong events where the positive track can be identified as a proton. $K^*(890)^-$ and $K^*(1400)^-$ are also observed in the two-prong-plus-V topology where the K^0 decay is observed. For missing neutron reactions, a study was made of the missing mass distributions to prove that the kinematical fits to $K^-\pi^+n$ and $K^0\pi^-\pi^+n$ final states could confidently be used to study $K^*(890)$ and $K^*(1400)^0$ production. Dissert. Abstr.

N68-32288 Indiana Univ., Bloomington.
DOPPLER SHIFT ATTENUATION METHOD DETERMINATIONS OF NUCLEAR LEVEL LIFETIMES IN N 14, F 19, NA 23, MG 24, MG 26, AL 27, AND SI 28
Stephen Walter-Robinson (Ph.D. Thesis) 1967 123 p
Available from Univ. Microfilms: HC $8.00/MF $3.00 Order No. 67-15155

The lifetimes of a number of nuclear excited states have been determined by a variation of the Doppler shift attenuation method. The experimental efforts were primarily directed at levels of Mg^{24}, Mg^{26}, and Si^{28}, while N^{14}, F^{19}, Na^{23}, and Al^{27} were studied in less detail. The excited states were produced by inelastic scattering of 22 MeV alpha particles. Gamma-ray spectra were collected at forward and backward angles to the beam direction in coincidence with pulses from alpha particles striking an annular solid state detector which subtended the extreme backward angles. Doppler shifts were observed in these gamma-ray spectra due to the forward motion of the recoil nuclei. The targets used in the work had thick backings of gold or magnesium in which the recoil nuclei were stopped. The observed Doppler shifts therefore depended upon the lifetimes of the excited states involved and the times required for the recoil nuclei to stop in the backing material. For cases in which the observed shifts were less than the maximum possible shifts calculated from the kinematics of the reaction, it was possible to calculate the nuclear lifetimes from the measured attenuations of the Doppler shifts and the stopping power of the backing material. Dissert. Abstr.

N68-32318 Johns Hopkins Univ., Baltimore, Md.
TOWARD A VECTOR MESON BOOTSTRAP IN B BAR B SCATTERING
William Franklin Palmer (Ph.D. Thesis) 1967 152 p
Available from Univ. Microfilms: HC $7.20/MF $3.00 Order No. 67-13819

An analysis is made of the coupled S-wave and D-wave $\bar{B}B$ scattering amplitudes. SU(3) symmetry is assumed. Cross symmetry is approximately satisfied by including in the t-channel (exchange singularities) the same particles which are expected in the s-channel (annihilation singularities). The coupled amplitudes are made unitary, within the elastic approximation, by including in the singlet and octet scattering matrices all possible coupled SU(3) and $J^P = 1^-\bar{B}B$ states. The problem is formulated in terms of a matrix set of coupled integral equations which are linearized by the ND^{-1} method. Bound state solutions are found in the SU(3) singlet and octet amplitudes corresponding to the observed nonet of vector mesons. The bound state solutions can be made self-consistent in mass. Predictions are made for the vector meson-baryon coupling constants. Questions of residue self-consistency are investigated; sensitivity and uniqueness of the solutions are discussed. Finally, inelastic effects are considered and improvements to the calculation are suggested. Dissert. Abstr.

N68-32329 Texas Univ., Austin.
POLARIZATIONS AND CROSS SECTIONS FOR ELASTIC AND INELASTIC PROTON SCATTERING FROM Be 9
Morris Raymond Kostoff (Ph.D. Thesis) 1967 90 p
Available from Univ. Microfilms: HC $4.60/MF $3.00 Order No. 67-14857

Differential cross section and absolute polarization angular distributions have been measured for protons elastically scattered from ^9Be in the laboratory energy range from 7.0 to 11.0 MeV. The inelastic differential cross sections for protons scattered from the 2.43 MeV level in ^9Be have also been measured for the same energies. At 11.0 MeV a polarization angular distribution for the 2.43 MeV proton group was also observed. The experimental apparatus and its application as a "calibrated" polarimeter are described in detail. A method for the fabrication of thick self-supporting carbon foils is described briefly. The data is analyzed using a diffuse surface optical model parameter search routine. A seven parameter search allowed the spin-orbit diffuseness parameter to vary rather than the spin-orbit radius. This fitting procedure resulted in extremely good fits to both the polarization and the cross section data. Dissert. Abstr.

N68-32335 Columbia Univ., New York.
NUCLEAR STRUCTURE EFFECTS IN SIMPLE HIGH ENERGY SPALLATION REACTIONS
Paul Jason Karol (Ph.D. Thesis) 1967 97 p
Available from Univ. Microfilms: HC $5.00/MF $3.00 Order No. 67-14056

Cross sections for the (p,pn), (p,p2n), (p,2pn), and (p,2p2n) reactions at 370 MeV with Ni^{58} and Zn^{64} were determined in anticipation of finding an explanation for the "anomalously low" $Ni^{58}(p,pn)Ni^{57}$ cross section of ~30 mb compared to ~80 mb for other medium mass nuclei. All of the cross sections for corresponding reactions were found to be lower with Ni^{58} than with Zn^{64}. These results rule out the explanation that the cross section for the $Ni^{58}(p,pn)Ni^{57}$ reaction is low because of an anomalous excitation-energy spectrum following a (P,PN) knockout. Detailed consideration is given to the roles played by the one-step

and the two-step mechanisms and nuclear structure in determining the high-energy (p,pn) cross section. It is concluded that the current theoretical models for simple spallation reactions are able to explain the anomalous (p,pn) cross section provided previously ignored details of nuclear structure are taken into proper account. Dissert. Abstr.

N68-32363# Kyoto Univ. (Japan). Research Inst. for Fundamental Physics.
AN ALTERNATIVE FORMULATION OF CHIRAL DYNAMICS
Ken Kawarabayashi and Shinsaku Kitakado Jun. 1968 12 p
(RIFP-72) CFSTI: HC $3.00/MF $0.65

An alternative formulation of chiral dynamics in which vector and axial vector mesons obey similar nonlinear chiral transformation rules as other hadrons is proposed. The KSRF relation ($g_\rho^2 = m_\rho^2/2$) and the Weinberg mass relation ($m_{A_1}^2 = 2m_\rho^2$) follow when the universality of ρ coupling to pions is supplemented. Author

N68-32393 California Univ., Berkeley.
DECAY PROPERTIES OF THE ξ HYPERON AND ξ HYPERON RESONANCES
Deane Whitney Merrill, Jr. (Ph.D. Thesis) 1967 194 p
Available from Univ. Microfilms: HC $8.80/MF $3.00 Order No. 67-11649

A sample of 2500 ξ^- and 500 ξ^0 hyperons, produced in ξK, $\xi K\pi$, and $\xi K\pi\pi$ final states by K^- (in H_2) at incident moments of 1.7 to 2.7 BeV/c, has been analyzed. The data are from an exposure ("K-63") of 26 events/μb in the 72-inch bubble chamber; approximately 85% of the ξ^- events and 60% of the ξ^0 events have been analyzed. Dissert. Abstr.

N68-32402# Kyoto Univ. (Japan). Research Inst. for Fundamental Physics.
SYMMETRY BREAKING OF CHIRAL SU(3)XSU(3) AND K-N SCATTERING LENGTHS
Ken Kawarabayashi and Shinsaku Kitakado Jun. 1968 9 p refs
(RIFP-73) CFSTI: HC $3.00/MF $0.65

Within the framework of chiral dynamics, S-wave kaon-nucleon scattering lengths are calculated by taking into account the effect of symmetry breaking of chiral SU(3)$\otimes$SU(3). The symmetry breaking term is assumed to transform like (3,3*) + (3*,3) under SU(3) $\otimes$ SU(3). The parameters are determined from the associated SU(3)-breaking mass term for the baryon octet. Author

N68-32484 Saskatchewan Univ., Saskatoon.
THE INELASTIC SCATTERING OF ELECTRONS FROM CARBON-12
George Atherley Beer (Ph.D. Thesis) 1966 126 p
Available from Univ. Microfilms: HC $6.20/MF $3.00 Order No. 67-6987

Measured values of the nuclear matrix element for the 19.4 MeV level in ^{12}C and the experimental equipment which was used for this investigation of nuclear structure by the technique of electron scattering are presented. Previous electron scattering measurements on this level have been made at momentum transfers less than 120 MeV/c and greater than 270 MeV/c. We have measured the matrix element for this level in the previously uninvestigated region of momentum transfers between 120 MeV/c and 220 MeV/c. All present measurements were made at the largest attainable scattering angle to enhance the transverse terms in the cross section. The experimental matrix elements have been compared with theoretical results both for a 1^- and for a 2^- level predicted to lie in this energy region. These theoretical particle-hole calculations show that in the region of intermediate momentum transfers which are investigated, the magnitude of the matrix element is most sensitive to the spin parity assignment. Dissert. Abstr.

N68-32485 Harvard Univ., Cambridge, Mass.
LOWER BOUNDS TO EIGENVALUES. THEORY OF RESONANCES IN SCATTERING AND THE RELATION TO THE DECAY OF A PREPARED STATE
William Hughes Miller (Ph.D. Thesis) 1967 91 p
Available from Univ. Microfilms: HC $4.80/MF $3.00 Order No. 67-14127

The method of comparison of operators is used to develop ways for determining lower bounds to the discrete eigenvalues of a Hermitian operator. The basic problem is to find an operator which is in some sense smaller than the operator of interest and which is simple enough for its eigenvalues to be found exactly--these eigenvalues are lower bounds to the unknown eigenvalues. A theoretical result is obtained for the positions and widths of resonances in the scattering of electrons from hydrogen atoms which has a particularly simple interpretation in terms of perturbation theory. Application to the 2s2p ^1P_u resonance in $He^+ + e^-$ scattering gave very good agreement with experiment. The formal relation between resonance scattering and the decay of a prepared state is discussed and it is shown that both physical models predict the same physically observable quantities. Dissert. Abstr.

N68-32531 Maryland Univ., College Park.
THE REACTIONS $K^- + p \rightarrow \Sigma^\pm + \pi^\pm + \pi^0$ NEAR 1755 MEV
Gordon Randolph Charlton (Ph.D. Thesis) 1967 139 p
Available from Univ. Microfilms: HC $6.00/MF $3.00 Order No. 67-11295

From a hydrogen bubble chamber exposure to a K^- meson beam, we have measured the differential cross sections for the reactions $K^- + p \rightarrow \Sigma^\pm + \pi^\pm$ and the total cross sections for $K^- + p \rightarrow \Sigma^\pm + \pi^\pm + \pi^0$ at 902, 929, 947, 960 and 990 MeV/c. We find very little momentum dependence of the two body cross sections and of the Σ^+ polarization in this interval, the mean polarization being $\alpha P \approx 0.5 \pm 0.1$. From the cross sections we estimate the $Y^*_1(1755) \rightarrow \Sigma^\pm + \pi$ branching ratio to be $0.01 \pm .01$. The three body final states are dominated by the excited hyperon states $Y^*_1(1385)$, $Y^*_0(1405)$, and $Y^*_0(1520)$, with no marked momentum dependences apparent. We find a branching ratio $T^*_1(1385) \rightarrow \Sigma + \pi$ of $0.08 \pm .03$. Although we observe interference effects which indicate that the sample of $Y^*_0(1520) + \pi^0$ events is contaminated by background amplitudes, the data are in good agreement with earlier results that the $Y^*_1(1755)$ has spin and parity $5/2^-$. Dissert. Abstr.

N68-32536 Northwestern Univ., Evanston, Ill.
AN INVESTIGATION OF THE Na 23 (d,α) Ne 21 REACTION
Richard Severin Cox (Ph.D. Thesis) 1967 84 p
Available from Univ. Microfilms: HC $4.40/MF $3.00 Order No. 67-15212

An investigation of the $Na^{23}(d,\alpha)Ne^{21}$ reaction has been made in order to study the reaction mechanism by which it proceeds. Differential cross sections to the ground and first seven excited states of Ne^{21} were obtained in twenty to fifty kilovolt steps between 2 and 4.2 MeV bombarding energies at seven angles from 10 to 170 degrees in the laboratory system. The measurements were carried out with energy resolutions of a few kilovolts and to accuracies in the neighborhood of five percent. The cross sections exhibited moderate fluctuations as a function of energy over ranges of several hundred kilovolts and analysis in terms of correlation functions indicate that they are not of the Ericson type. The partial equilibrium model for nuclear reactions of K. Izumo correctly predicts the spacing of maxima in the cross sections when six or seven nucleons of the compound system are assumed to share the energy of the incoming deuteron. Hence, it is concluded that the $Na^{23}(d,\alpha)Ne^{21}$ reaction proceeds through an intermediate process at these relatively low bombarding energies. Dissert. Abstr.

N68-32552 California Univ., Los Angeles.
ELASTIC SCATTERING OF 14 MeV NEUTRONS BY DEUTERONS
Alan Coleman Berick (Ph.D. Thesis) 1967 143 p
Available from Univ. Microfilms: HC $6.80/MF $3.00 Order No. 67-14293

The differential cross section for the elastic scattering of neutrons by deuterons was measured at a neutron energy of 14.3 ± 0.2 MeV. The T(d,n)He^4 reaction was used as the source of neutrons. The data cover the center of mass scattering angles from 13.53° to 158.57° and the cross section at each angle was measured with a statistical accuracy from 2 to 3%. The scattering target was a deuterated benzene scintillator coupled to a 58AVP photomultiplier tube. The time of flight of the scattered neutron was measured by utilizing the recoil deuteron pulse in the target counter to start the timer and a pulse produced by the scattered neutron in a 58AVP photomultiplier tube fitted with a plastic scintillator to stop it. Background events were limited by placing pulse height restrictions on the pulses from the target counter. In some cases this was accomplished through the simultaneous use of both pulse height and time of flight in a two parameter analysis, and in the remaining cases by the use of a single channel pulse height analyzer to select the pulse height of the recoil deuteron. Dissert. Abstr.

N68-32597# Frankford Arsenal, Philadelphia, Pa. Pitman-Dunn Research Labs.
NEUTRON CAPTURE GAMMA RAY SPECTROSCOPY
Michael Wiest Jan. 1968 44 p refs
(FA-M68-16-1; AD-671622)

Theoretical curves of the gamma ray spectra have been obtained for five arbitrarily chosen metals - aluminum, copper, iron, nickel, and zinc. A 2 by 2 by 1/2 centimeter sample was considered. The neutron flux used was 10 to the 8th power neutrons per second radiated into 4 pi geometry. The crystal was a thallium-activated sodium iodide right cylindrical crystal, 4 in. diameter by 4 in. high. For comparison, a curve for a lithium-drifted germanium crystal was also obtained. In the NaI curves, both absorbed and scattered neutrons were considered. Background was neglected in both cases. Author (TAB)

N68-32609# Massachusetts Inst. of Tech., Cambridge. Fluid Dynamics Research Lab.
EXPERIMENTS ON SCATTERING OF MONO-ENERGETIC ARGON BEAMS BY HEATED PLATINUM
James Patrick Moran Feb. 1968 230 p refs
(Contracts AF 49(638)-1601; Nonr-3963(03))
(T-68-1; AFOSR-68-0319; AD-671915)

Time-of-flight (TOF) measurements were made in both heated and unheated initially mono-energetic argon beams before and after reflection from heated platinum targets. A new and quite simple beam source is described which generates the high intensity, nearly mono-energetic incident beam. Targets were prepared by chemical cleaning. Beams directed at these targets were reflected in directed nonspecular lobes and the molecular TOF distributions in these lobes were investigated. Low order moments of the velocity distribution are obtained directly from the TOF data by integrating the TOF curves after they are weighted by appropriate, derived functions. Relative number flux, momentum flux and energy flux are obtained and ratios of these fluxes yield mean speed and mean energy as a function of angle of reflection. These flux moments are also used to calculate a speed ratio which provides a measure of spread in speed distribution divided by the mean speed. These integrated results are presented for incident beam angles of 20, 40, 55, 65, and 80 degrees, to the target normal and a target temperature of 1000C. In all cases reflected mean momentum and energy show a marked angular dependence, decreasing with increasing angle of reflection from the target normal at a given angle of incidence. The mean tangential velocity is close to the incident beam value over a range of reflection angles which contain most of the reflected particles. The speed ratio at all angles of reflection is appreciably larger than the incident beam value. The differential energy accommodation coefficient increases with increasingly glancing angles and decreases with increasing angle of reflection. Author (TAB)

N68-32683# Idaho Nuclear Corp., Idaho Falls. National Reactor Testing Station.
TOPICAL REPORT: RESONANCE INTEGRALS MEASURED IN THE ADVANCED REACTIVITY MEASUREMENT FACILITIES
J. J. Scoville and J. W. Rogers Jun. 1968 19 p refs
(Contract AT(10-1)-1230)
(IN-1195) CFSTI: HC $3.00/MF $0.65

The results of several years' effort of this laboratory in the measurement of resonance absorption integrals are disclosed. Although the results included have been previously reported in the open literature of the field, as has been the description of the various experimental techniques involved in these measurements, it was considered timely that all the results to date should be included in one document. References to the original publication of each resonance integral value are given. Author (NSA)

N68-32706# Deutsches Elektronen-Synchrotron, Hamburg (West Germany).
THEORY OF DOUBLE PION PHOTOPRODUCTION AT LOW ENERGIES
D. Lueke (Hamburg Univ.), M. Scheunert (Hamburg Univ.), and P. Stichel Apr. 1968 22 p refs
(DESY-68/7)

The process $\gamma + p \rightarrow \Delta^{2+}(1236) + \pi^-$ at low energies is discussed by taking into account the gauge invariant extended OPE-contribution and a small admixture of isobaric contributions. Reasonable agreement with recent experimental data from the Aachen, Berlin, Bonn, Hamburg, Heidelberg, München collaboration is obtained. Author (NSA)

N68-32717# Eidgenoessiches Institut fuer Reaktor Forschung, Wurenlingen (Switzerland).
ENERGY DEPENDENT NEUTRON BRANCHING PROCESSES [ENERGIE ABHAENGIGE NEUTRONEN-VERZWEIGUNGSPROZESSE]
P. Waelti Mar. 1968 43 p refs In GERMAN
(EIR-133)

A model was derived to describe the time development of neutron density in the energy space. The neutron transport was inserted into the formalism of the age-dependent branching process. In place of the Boltzmann equations, a simple regeneration equation is obtained. NSA

N68-32719# Deutsches Elektronen-Synchrotron, Hamburg (West Germany).
CURRENT ALGEBRA [STROMALGEBRA]
P. Stichel Apr. 1968 19 p refs In GERMAN; ENGLISH summary
(DESY-68/19)

A short review of the content of current algebra, its main results, and its role within present elementary particle physics is given. Author (NSA)

N68-32730# Deutsches Elektronen-Synchrotron, Hamburg (West Germany).
STUDY OF TWO NEGATIVE PIONS ELASTIC SCATTERING IN THE REACTION NEGATIVE PION PLUS PROTON

YIELDS POSITIVE NUCLEON RESONANCE PLUS TWO PIONS AT 11 GeV/c

C. Caso, F. Conte, G. Tomasini et al Apr. 1968 26 p refs
(DESY-68/18)

Experimental data on the reaction $\pi^-p \rightarrow N^{*2+}\pi^-\pi^-$ are presented. For events with low momentum transfers ($\Delta^2 < 0.3(GeV/c)^2$) the nonresonant background in the N^{*2+} region is about 19%. Applying different versions of the OPE model, values for the elastic $\pi^-\pi^-$ cross section for energies of the $\pi\pi$ system up to 1.72 GeV are obtained. Distributions of the $\pi\pi$ scattering angle are shown for different regions of the $\pi^-\pi^-$ energy. Author (NSA)

N68-32731# Deutsches Elektronen-Synchrotron, Hamburg (West Germany)

MEASUREMENTS OF SINGLE NEGATIVE AND POSITIVE PION PHOTOPRODUCTION AT SMALL MOMENTUM TRANSFERS

P. Heide, U. Koetz, R. A. Lewis, P. Schmueser, H. J. Skronn et al May 1968 20 p refs
(DESY-68/22)

Single π^- and π^+ photoproduction from deuterium was measured at gamma energies from 2.6 to 6 GeV and momentum transfers between 0.005 and 0.6 $(GeV/c)^2$. The π^-/π^+ ratio is found to be unity near the forward direction and drops to about 0.3 at larger angles. The data support the existence of a forward peak in π^- photoproduction on neutrons. Author (NSA)

N68-32782# Michigan Univ., Ann Arbor.

RESONANCE SCATTERING OF RADIATION BY INTERACTING ATOMS

Dwight Donald Hearn (Ph.D. Thesis) 1968 86 p refs
(Contract AT(11-1)-1112)
(COO-1112-162) CFSTI: HC $3.00/MF $0.65

The damping theory of Heitler and Ma is applied to a system consisting of two ground-state atoms in a radiation field. Calculations include expressions for the expansion coefficients of the state vector, lifetimes of the excited atomic states, probability amplitude for the final states, and line shapes for the emitted radiation. Comparisons are made with the resonance fluorescence of a single, two-level atom and with the decay of an excited two-level atom in the presence of an identical ground-state atom. The line shape obtained is shown to be significantly different from those obtained for both one- and two-atom cases already studied. NSA

N68-32786# Kyoto Univ. (Japan). Research Inst. for Fundamental Physics.

SPECULATIONS ON POSSIBLE SU(3)-MULTIPLET STRUCTURES FOR HIGHER MESON RESONANCES

Komaziro Niizeki Jun. 1968 16 p refs
(RIFP-74) CFSTI: HC $3.00/MF $0.65

There have been reported many resonances of mesons above 1,600 MeV. However, detailed properties for these resonances have not yet been established. In this paper, two alternative possibilities for SU(3)-multiplet structures for higher meson resonances are proposed based on the analysis for partial decay widths of the L meson. Validity of the proposals is discussed. Author

N68-32788 California Inst. of Tech., Pasadena.

A STUDY OF THE REACTION Li 6 (CARBON 12, D) O 16 ABOVE THE COULOMB BARRIER

Clyde Stewart Zaidins (Ph.D. Thesis) 1967 152 p
Available from Univ. Microfilms: HC $7.20/MF $3.00 Order No. 67-14357

The angular distributions of deuterons from the reaction $^6Li(^{12}C,d)^{16}O^*$ leading to the ground state and first eight excited states of ^{16}O have been measured at a center of mass energy of 7 MeV. The angular distributions of deuterons leading to the third, fourth, and fifth excited states have been also measured at 8 MeV, and excitation functions for these levels at θ LAB = 30° and 50° have been taken for these levels from 6 to 8 MeV. The results have been analyzed by calculating a theoretical contribution to the total cross sections due to the formation and decay of the compound nucleus ^{18}F in a statistical region of excitation by a Hauser–Feshbach calculation. This contribution is then subtracted from the total, neglecting any interference effect, and the difference is related to a reduced alpha width of the ^{16}O final states that might be measured in a purely direct alpha transfer reaction. The astrophysical significance of the reduced alpha width of the fourth excited state is discussed. Dissert. Abstr.

N68-32789 Northwestern Univ., Evanston, Ill.

IDENTIFICATION OF SINGLE-PARTICLE STATES IN THE FISSION TRANSITION NUCLEUS U^{236}.

Aziz Nosrat Behkami (Ph.D. Thesis) 1967 123 p
Available from Univ. Microfilms: HC $6.00/MF $3.00 Order No. 67-15188

Fission fragment angular distributions have been measured for the fission of U^{234} induced by monoenergetic neutrons of energies 200, 300, 400, 500, 600, 700, 843, 998, and 1185 keV. Neutrons produced by the $Li^7(p,n)$ reaction, with an energy spread of about 15 keV, impinge on an isotopically pure U^{234} target of 0.5 mg cm^{-2} thickness and 1/8 inch diameter. The fission fragments are detected as a function of angle in 2π geometry with a polycarbonate resin detector. The overall angular resolution of the system including the neutron direction is about 7°. Corrections are made for angular resolution and the contribution of the lower energy neutron group which leaves Be^7 in its first excited state. The data were not corrected for fission induced by scattered neutrons because the calculated magnitude of this effect is small—between 2–4% depending on neutron energy. Dissert. Abstr.

N68-32896 Indiana Univ., Bloomington.

AN ELECTRON DIFFRACTION STUDY OF HELIUM, NEON, ARGON, KRYPTON AND XENON

Hollace Lawton Cox, Jr. (Ph.D. Thesis) 1967 129 p
Available from Univ. Microfilms: HC $6.20/MF $3.00 Order No. 67-15079

Total intensity curves of electrons scattered by He, Ne, Ar, Kr and Xe have been measured for 40 kV incident electrons by means of the gas electron diffraction method. These experimental intensity curves have been compared with theoretical intensity curves calculated using both the first Born approximation and partial wave elastic scattering amplitudes in the elastic portion of the total scattered intensity. Hartree–Fock inelastic scattering factors determined by Tavard were used in the inelastic portion through Kr and for Xe inelastic scattering factors were obtained using the plane wave approximation suggested by Liberman. In the calculation of the first Born and partial wave scattering amplitudes and the plane wave inelastic scattering factors, the static atomic potential field was represented by an analytic function containing a sum of Yukawa terms. Parameters for this potential function were obtained from least squares fits of an analytic radial electron distribution function, D(r). Dissert. Abstr.

N68-32922 Polytechnic Inst. of Brooklyn, N. Y.

QUANTUM-STATISTICAL DISTRIBUTION FUNCTIONS OF A HARD-SPHERE SYSTEM

Chester J. Nisteruk (Ph.D. Thesis) 1967 121 p
Available from Univ. Microfilms: HC $6.00/MF $3.00 Order No. 67-13411

The present investigation approaches the calculation of the distribution functions of a hard-sphere system from a more general point of view in the following sense: The binary kernel method of calculating the p.d.f. is related to the approach previously developed

for Fourier transformable potentials. To first order in binary kernel the two are shown to be equivalent. For Boltzmann statistics a more general set of chain diagrams, of which the simple chain and tick-tack-toe are special cases, is summed. The result is expressed in terms of the singlet evaluated in the same approximation. It is shown that within the hard-sphere boundary ($r<a$) the first-order binary kernel fails to reproduce the two-particle cluster function, U_2, taken to the same order. With the correct quantum-mechanical expression for U_2 the p.d.f. vanishes for $r<a$. An explicit expression for the p.d.f at absolute zero is given in terms of a universal function defined in terms of G_s, the difference of modified Bessel and Struve functions. Dissert. Abstr.

N68-32927# California Univ., Livermore. Lawrence Radiation Lab.

PHOTONEUTRON CROSS SECTIONS OF POLARIZED HOLMIUM 165

Michael A. Kelly (Ph.D. Thesis) 1 May 1968 87 p refs

(UCRL-50421) CFSTI: HC $3.00/MF $0.65

The (γ,n) and (γ,2n) cross sections of polarized ^{165}Ho were measured between 10 and 20 MeV using nearly monoenergetic photon beam from the Livermore linear accelerator. Two independent cross sections were obtained by orienting the polarization axis perpendicular to and parallel to the photon beam direction. From these, the cross sections corresponding to the intrinsic modes of the giant resonance are computed. The target consisted of nine single crystals of holmium metal, having a total mass of 50 g and was polarized by cooling to approximately 0.13°K in the presence of the 15-kOe field. The alignment parameter f_2 was determined to be 0.43 ± 0.05 by measuring the anisotropy of the gamma rays emitted by ^{166m}Ho (created in the target by neutron activation). The total photoneutron cross section, $\sigma_t = \sigma(\gamma,n) + \sigma(\gamma,2n) + \sigma(\gamma,np)$, exhibited an anisotropy in both major peaks of the giant resonance that agrees qualitatively with the collective model for deformed nuclei. Author (NSA)

N68-32949# Rome Univ. (Italy). Inst. of Physics.

INTERFERENCE OF ρ^0 AND ω STATES IN $e^+e^- \rightarrow \pi^0\gamma$, $\pi\gamma$

G. Benfatto 24 Jan. 1968 10 p refs *Its* Internal Note No. 153

(NP-17476)

It is assumed that the $\pi^0\gamma$ and $\pi\gamma$ states produced in $e^+ + e^-$ annihilation interactions, with a total cm energy 2E between 700 and 800 MeV, are dominated by the ρ^0 and ω resonances. The interference of these resonances is studied by means of the quark model. The calculated cross section for this reaction is shown. NSA

N68-32950# Rome Univ. (Italy). Inst. of Physics.

ON THE GROUP THEORETICAL APPROACH TO THE CONSPIRACY PROBLEM FOR ARBITRARY MASSES

G. Cosenza, A. Sciarrino, and M. Toller (CERN) 12 Feb. 1968 116 p refs *Its* Note No. 158

(NP-17483)

The scattering amplitude for an arbitrary two-particle process is written as a function $Tm^{W}{}_{1}m_2m_3m_4(h)$ where W is the square of the four-momentum transfer and h is an element of a subgroup $H^{c}{}_{W}$ of the complex Lorentz group. If suitable conventions are used, this function is shown to be free of kinematic singularities and free of kinematics constraints apart from two covariance conditions of group theoretical nature. The usefulness of this function in the treatment of the kinematic conditions in a Regge pole model is shown and discussed. The matrix elements of the representations of the homogeneous Lorentz group are used in order to obtain explicit expressions for this function, which satisfy, above a certain energy, all the requirements of analyticity and covariance. These expressions are equivalent to the contribution of a family of parallel conspiring Regge trajectories with well-defined quantum numbers. Both equal and unequal mass reactions are considered. Author (NSA)

N68-32951# Rome Univ. (Italy). Inst. of Physics.

NARROW-RESONANCE SATURATION OF SUM-RULES: A NON-UNIQUENESS THEOREM

D. Atkinson 15 Jan. 1968 58 p refs Its Internal Note No. 149

(NP-17474)

It is shown that, if the superconvergence relations pertaining to a two-particle scattering process are saturated by an infinite tower of resonances of mass m_J, where J is the spin, then m_J must increase less quickly than J in all cases. With this observation, it is shown that the complex of all the superconvergence relations for all the processes $a(J_1) + a(J_2) \rightarrow a(J_3) + a(J_4)$, where a(J) is the spin-J member of the same tower of particles, possesses an infinity of solutions for the coupling constants. It is concluded that the superconvergence relations are incomplete, and need to be supplemented by some new physical principle, if they are to be of any practical use. A possible exception to this rule is when all but a finite number of residues are constrained to be positive, with no negative coefficient from the isospin crossing matrices. In this case, a given solution may be unique if m_J increases not more quickly than $J^{1/2}$. Author (NSA)

N68-32954# Oak Ridge National Lab., Tenn.

PRODUCTION OF CHARGED PIONS IN COLLISIONS OF NEUTRONS OF 600 MeV ENERGY WITH NUCLEI OF VARIOUS ELEMENTS

K. O. Oganesyan [1967] 19 p refs Transl. into ENGLISH from Joint Inst. for Nucl. Res. Rept. JINR-P1-3399

(ORNL-TR-1924) CFSTI: HC $3.00/MF $0.65

The production of charged pions in neutron–nucleus collisions was studied by means of a magnetic spectrometer in a broad angular interval. Investigations were carried out on nuclei of beryllium-9, carbon-12, aluminum-27, copper-64, and lead-207 in the neutron beam of a synchrocyclotron. The various cross sections, spectra, and angular distributions are shown. NSA

N68-32984 National Lending Library for Science and Technology, Boston Spa (England).

THE DISCOVERY OF NUCLEAR PROPERTIES OF LIGHT

A. M. Baldin [1968] 2 p Transl. into ENGLISH from Sov. Rossia (USSR), 11 Apr. 1968

(M-7354) Available from Natl. Lending Library, Boston Spa, Engl.

The U.S.S.R. investigation of the mutual transformation of photons and vector mesons into each other is briefly discussed. B.S.D.

N68-32969# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.

STUDY OF THE INTERNAL CONVERSION ELECTRONS FROM THE DECAY OF ND147 TO PM147

Edward B. Danber (M.S. Thesis) May 1968 97 p refs

(GNE/PH/68-6; AD-671932)

Sources of Nd147 were produced by neutron irradiation of Nd146 deposited by vacuum sublimation onto aluminum foil backings. The internal conversion electron spectrum was studied with an iron-core 50.5-cm radium beta-ray spectrometer. The transition energies (in keV) were 91.04 plus or minus 0.05, 120.44 plus or minus 0.05, 196.67 plus or minus 0.08, 275.46 plus or minus 0.08, 319.45 plus or minus 0.09, 398.04 plus or minus 0.09, 410.33 plus or minus 0.29, 439.78 plus or minus 0.09, 530.92 plus or minus 0.06, 589.03 plus or minus 0.12, 594.59 plus or minus 0.12 and 685.78 plus or minus 0.07. The 489 K line was observed, but the energy could not be accurately determined.

Internal conversion coefficients were determined with the aid of relative gamma-ray intensities from other experiments. Possible multipolarity assignments were made. Author (TAB)

N68-32979# Louvain Univ. (Belgium). Inst. for Theoretical Physics.
BOSON 27-PLET IN THE UNITARY SYMMETRY MODEL
R. Gastmans and F. Halzen [1967] 17 p refs
(NP-17486)

The mass formulas and decay rates of a 27-plet of bosons in the unitary symmetry model are investigated. The specific example considered is the $I=2\rho-\pi-$ resonance at 1320 MeV. Identification of particle states and tensors in a 27-plet, mass relations for a 27 irreducible representation, the Martin effective threshold method, the TVP vertex in the octet dominance approximation, mass relations for a reducible $1+8+27$ representation, and the 405 as a candidate for meson resonances are discussed. NSA

N68-32993# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics.
CP INVARIANCE IN WEAK RADIATIVE DECAYS [NARUSHENIE CP-INVARIANTNOSTI V SLABYKH RADIATSIONNYKH RASPADAKH]
A. T. Filippov 1968 23 p refs In RUSSIAN
(JINR-P2-3743)

Results of the CP and T invariance in various interactions indicate that only a limited number of interaction mechanisms, such as the ministrong hadron interaction, the miniweak lepton interaction, may be used as a theoretical model and experimental study method. The potential existence of the weak electromagnetic interaction is of great interest. No general principles have as yet been developed to allow a reasonable choice between the various mechanisms. In some cases, weak radiation processes may yield information also about miniweak processes; this is illustrated by specific examples. In view of the scarcity of information about weak radiative processes, in the study of the CP invariance, attention was focused on phenomenological analysis. Disturbances in CP and T invariance in weak radiative processes may be due to forbidden decays, charge asymmetry, forbidden peaks, conservation-forbidden CP interference in the decay of neutral K mesons, destruction of the equilibrium, electric dipole moments of electrons, neutrons and muons, etc. NSA

N68-32996# California Univ., Berkeley. Lawrence Radiation Lab.
THE $K^+p\rightarrow K^+\pi^-\Delta^{++}$ INTERACTION AT 4.6 AND 9 BeV/c
C. Fu, A. Firestone, G. Goldhaber, G. H. Trilling, and B. C. Shen 18 Apr. 1968 14 p Presented at the Conf. on Exptl. Meson Spectry., Philadelphia, 26-27 Apr. 1968
(Contract W-7405-ENG-48)
(UCRL-18201; CONF-680428-2) CFSTI: HC $3.00/MF $0.65

An attempt is made to test the extent to which the entire reaction $K^+p\rightarrow K^+\pi^-\Delta^{2+}(1236)$ can be understood on the basis of one pion exchange domination modified by absorption effects. It is found that at least three and possibly four distinct effects are needed to interpret the experimental results. These are: $K^*(890)+\Delta^{2+}$, where the $K^*(890)$ exhibits the well-known p-wave $K\pi$ scattering features with some s-wave interferences, $K^*(1420)+\Delta^{2+}$, where the $K^*(1420)$ shows the features corresponding to d-wave $K\pi$ scattering and thus $J^P=2^+$, a $\pi-\Delta^{2+}(1238)$ enhancement in the mass region 1400 to 1700 MeV, and the question of whether there is evidence for a $0^+K\pi$ resonance. NSA

N68-33011# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics.
HYPOTHESIS OF COMMUTATIVE SUPERSELECTION RULES
S. G. Kharatyan and A. I. Oksak 1968 10 p refs
(JINR-E2-3799)

The hypothesis of commutative superselection rules is a consequence of the assumption: the linear hull of the set of physically realizable vectors is dense in the Hilbert space. Author (NSA)

N68-33049 Boston Univ., Mass. Graduate School.
DISCRETE SYMMETRIES AND SU(e) IN NON-LEPTONIC WEAK DECAYS AND IN ELECTROMAGNETIC DECAYS OF HADRONS
Suck-Koo Yun (Ph.D. Thesis) 1967 196 p
Available from Univ. Microfilms: HC $9.00/MF $3.00 Order No. 67-13270

A phenomenological theory of non-leptonic weak decays which does not rely on the octet dominance and R or RP invariance is proposed. Postulating SU(3) symmetry and various discrete symmetry properties, a minimal Hamiltonian H_w is uniquely obtained in terms of a C-invariant and a C-non-invariant part respectively in such a way that the H_w is CP invariant. The C-invariant part transforms like octet members and the C-noninvariant part like decuplets. This H_w is applied to non-leptonic hyperon decays, and all s- and p-wave amplitudes are computed in terms of fifteen reduced matrix elements, eight for s-wave amplitudes and seven for p-wave amplitudes, after applying the Wigner-Eckart theorem. The application of C-invariant properties reduced the number of reduced matrix elements to six, two for s-wave amplitudes and four for p-wave amplitudes. Dissert. Abstr.

N68-33050 Rochester Univ., N. Y.
TWO PN EXPERIMENTS AT 200 MEV: ASYMMETRIES FROM CARBON AND DEUTERIUM, AND A MEASUREMENT OF THE TRIPLE SCATTERING PARAMETER D_t
David Spalding (Ph.D. Thesis) 1967 117 p
Available from Univ. Microfilms: HC $5.80/MF $3.00 Order No. 67-13651

We have performed a double and a triple scattering experiment. The double scattering experiment was performed on targets of deuterium and carbon, using 215 MeV, 85% polarized protons as incident particles. The asymmetry of recoil neutrons was measured at laboratory angles between 10° and 35°, using a neutron counter consisting of a polyethylene converter and multi-element scintillation telescope. The deuterium measurements are related to the free n-p polarization parameter by an impulse approximation calculation. The deuterium results are in good agreement with the predictions of Yale phase shift solutions 3, 3M, 4M, and the new Livermore solution, and are incompatible with Yale solutions 0, 1, 2, 2M. The asymmetries from carbon agree with free n-p scattering except at laboratory angles of 10° and 35°, where they are greater in absolute value. The asymmetry from carbon showed the greatest dependance on neutron energy at these angles. Dissert. Abstr.

N68-33063# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics.
MESON-NUCLEI INTERACTION AT VERY HIGH ENERGIES [MEZON-YADERNYE VZAIMODEISTVIYA PRI OCHEN'VYSOKIKH ENERGIYAKH]
I. Z. Artykov and V. S. Barashenkov 1968 10 p refs In RUSSIAN Submitted for publication
(JINR-P4-3800)

Inelastic interactions of π-mesons with the emulsion nuclei at an average energy of 200 GeV are considered by means of the intranuclear cascade model. It is taken into account that several

fast particles can interact simultaneously with one internuclear nucleon. The number of such many-particle interactions is more than a third from the total number of elastic and inelastic collisions of fast particles inside the nucleus. The results of calculations agree well with experiment. Author (NSA)

N68-33064# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics.
SUPERCONDUCTIVITY IN THE QUARK MODEL AND THE NUCLEON METASTABILITY [SVERKHPROVODIMOST' V MODELI KVARKOV I METASTABIL'NOST' NUKLONA]
Yu. M. Malyuta 1968 7 p refs In RUSSIAN
(JINR-P2-3819)

It is shown that the nucleon is a superconductive state constructed of three quarks with zero masses. The temperature corresponds to the phase transition of the second type, resulting in nucleon decay into quarks with the energy release equal to nucleon mass. As a result of the state reconstruction, the antileptons may turn out to be the final products of the nucleon decay.
Author (NSA)

N68-33074 Rochester Univ., N. Y.
A MEASUREMENT OF RADIATIVE PROTON–DEUTERON INTERACTIONS AT 197 MeV
Peter Friedrich Max Koehler (Ph.D. Thesis) 1967 170 p
Available from Univ. Microfilms: HC $7.80/MF $3.00 Order No. 67-13630

Radiative p-d interactions have been studied at 197 MeV by bombarding a target of liquid deuterium with a 90% polarized proton beam. A γ-detector gave the directions of photons of energy $E\gamma \geq 40$ MeV; spark chambers triggered by large-area counters were used to determine the direction(s) and range(s) of the energetic charged particle(s) which emerged in coincidence with a γ-ray. Samples of events from three final states were extracted: (1) $p+d \rightarrow {}^3_2He+p+\gamma$; (2) $p+d \rightarrow p_s+d+\gamma$; (3) $p+d \rightarrow p+d+\gamma$. Events of type (1) exhibited angular distributions and a γ-spectrum in agreement with free ppγ results, while the cross sections were reduced by a factor of 0.46 ± 0.10. Differential cross sections for reaction (2) were found to be reduced by a factor of 0.75 ± 0.15 from the values predicted for the free pick-up reaction; the γ-ray asymmetries were in good agreement with predictions from deuteron photo-disintegration. The cross section for reaction (3) was small and its study was strongly limited by the detection thresholds of the spark chambers. Events from the reaction $p+d \rightarrow p_s+n+p+\gamma$ could not be directly determined with our apparatus.
Dissert. Abstr.

N68-33077# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics.
QUANTUM THEORY OF SCALAR FIELD IN DE SITTER SPACE-TIME [KVANTOVAYA TEORIYA SKALYARNOGO POLYA V PROSTRANSTVE DE SITTERA]
E. A. Tagirov and N. A. Chernikov 1968 49 p refs In RUSSIAN
Submitted for publication
(JINR-P2-3777)

The quantum theory of scalar field is constructed in the de Sitter spherical world. The conserved quantities are obtained which correspond to isometric and conformal transformations. The Fock representations with the cyclic vector, which is invariant under isometries, are shown to form a one-parametric family. They are inequivalent for different values of the parameter. However, its single value is picked out by the requirement for motion to be quasiclassic for large values of square of momentum space. Then the basis vectors of the Fock representation can be interpreted as the states with definite number of particles. Author (NSA)

N68-33080# Brussels Univ. (Belgium). Dept. of Nuclear Physics.
THE NON-MESONIC DECAY OF HELIUM HYPERNUCLEI
G. Coremans, J. Sacton, D. H. Davis (Univ. Coll., London), J. E. Allen (Westfield Coll., London), and A. Fishwick (Westfield Coll., London) Apr. 1968 15 p refs *Its* Bull. No. 35
(NP-17481)

The nonmesonic decays of hypernuclei which emit two charged particles were analyzed. The events were produced in absorption of K− mesons at rest in nuclear emulsions. From a knowledge of the numbers of π^- mesonic decays of various species found from the same sample of K− meson capture stars and also the non-mesonic decay parameters deduced from ${}^4_\Lambda He$ decays in a helium bubble chamber, an attempt was made to determine the rates of the different nonmesonic decay modes of the ${}^5_\Lambda He$ hypernucleus. Some properties of the ${}^5_\Lambda He \rightarrow {}^1H^3Hn$ process are established. Author (NSA)

N68-33098# Michigan Univ., Ann Arbor.
A SEARCH FOR STABLE FRACTIONALLY CHARGED PARTICLES
David M. Rank (Ph.D. Thesis) 1967 84 p refs
(Contract AT(11-1)-1112)
(COO-1112-155) CFSTI: HC $3.00/MF $0.65

A search for stable fractionally charged particles called quarks is described. These particles form an elegant yet simple model which can explain the SU_3 symmetry of strongly interacting particles. Three different quarks and their corresponding antiparticles with charges $\pm 1/3e$ $\pm 2/3e$ are required by the theory. Three quarks bound together in relative S states produce a baryon and a quark-antiquark combination produces a meson. All known strongly interacting particles can be formed from combinations of these six quarks. Atoms formed with a $+2/3$ quark as a nucleus and an electron were sought with the aid of optical spectroscopy by an attempt to observe their Lyman series. Various substances were examined: sea water, lake water, seaweed, oysters, and plankton. A second series of experiments which attempted to detect fractional charges on oil drops also yield a null result. Various oils were used: mineral oil, soya bean oil, peanut oil, and cod-liver oil. The null result indicated that the concentration of quarks in these oils was $\geq 3 \cdot 10^{30}$ quarks/nucleon. Author (NSA)

N68-33110 Boston Univ., Mass.
SYMMETRY ALGEBRAS OF MECHANICAL SYSTEMS
Badri Munir Aghassi (Ph.D. Thesis) 1967 153 p
Available from Univ. Microfilms: HC $7.20/MF $3.00 Order No. 67-13273

The results obtained on the degeneracy of the harmonic oscillator are represented. The symmetry of the unitary groups are studied based on this dynamical model; and a similar model for the symplectic groups is obtained. Since the mechanical models of the uncoupled oscillators generate only the symmetric representations of the groups in question, information concerning the other representations are obtained by defining them as the sums of direct products of symmetric representations. This is achieved by generalizing the concept of finite-dimensional vector spaces to zero and negative dimensions, thus obtaining the ring of unitary unimodular vector spaces. Dissert. Abstr.

N68-33114# Princeton Univ., N. J. Palmer Physical Lab.
THE SPINS AND MOMENTS OF In 110 AND In 112
Bo R. Casserberg (Ph.D. Thesis) May 1968 103 p refs
(Contract AT(30-1)-937; Grant NSF GP-579)
(PUC-937-321) CFSTI: HC $3.00/MF $0.65

The spins and hyperfine interaction constants of ^{110}In (66 min.) and ^{112}In (14 min.) in the $^2P_{3/2}$ atomic state were measured by atomic beam magnetic resonance techniques. The isotopes were produced by bombardment of natural cadmium by 17.5-MeV protons in the Princeton cyclotron. A new, simple, and rapid method of separating the radioactive indium from the

cadmium was devised. Stable indium carrier was added to the irradiated cadmium in the beam apparatus oven; and the cadmium was evaporated, leaving the radioactive indium with the stable carrier. The temperature was then raised to the proper one for atomic beam production, and beam collection could begin 15 min after the cyclotron bombardment. The magnetic resonance measurements gave the following results: ^{110}In: I = 2, A = 429.20 (36) MHz, B = 192.5(7) MHz, $g_J = -1.33411(6)$. ^{112}In: I = 1, A = 554(4) MHz, B = 48.3(25) MHz. The hyperfine interaction constants give the following values for the nuclear moments: ^{110}In: $\mu = 4.360(4)\mu_N$, $Q = 0.34(2) \cdot 10^{-24}$ cm^2; and ^{112}In: $\mu = 2.81(3)\mu_N$, $Q = 0.086(5) \cdot 10^{-24}$ cm^2. The perturbations of the $^2P_{3/2}$ hyperfine levels caused by the nearby $^2P_{1/2}$ state were considered. Author (NSA)

N68-33133# Brookhaven National Lab., Upton, N. Y.
A MESH-ITERATION PROGRAM FOR FIELD CALCULATIONS IN LINAC CAVITIES
G. Parzen [1968] 7 p refs Presented at the Conf. on Proton Linear Accelerators, Upton, N. Y. Sponsored by AEC
(BNL-12537; CONF-680515-2) CFSTI: HC $3.00/MF $0.65

The application of the JESSY mesh-iteration computer program to the calculation of the fields and resonant frequency of cells in a 200-MeV proton linac is discussed. The iteration procedure, convergence acceleration technique, and the accuracy of the JESSY program are reported. NSA

N68-33148# Joint Inst. for Nuclear Research, Dubna (USSR).
SCATTERED RADIATION IN ACCELERATOR HALLS
L. R. Kimel and M. M. Komochkov 1967 32 p refs Transl. into ENGLISH from Rept. JINR-P9-3402
(NP-TR-1663) CFSTI: HC $3.00/MF $0.65

The problems of stray radiation in accelerator halls have been considered. Approximate formula for calculation of stray radiation fluxes of different energy groups are obtained. The method suggested is applied for calculations of stray radiation fields at the JINR synchrocyclotron hall. Author (NSA)

N68-33150# Brookhaven National Lab., Upton, N. Y.
LOWER EXCITED STATES OF Ta^{182}
Ya. K. Alksnis, M. K. Balodis, and P. T. Prokof'ev [1968] 11 p refs Transl. into ENGLISH from the Rept. Submitted for publication
(BNL-TR-215) CFSTI: HC $3.00/MF $0.65

The spectrum of conversion electrons emitted during the reaction $^{181}Ta(n,\gamma)^{182}Ta$ was measured using a β spectrograph with a resolution of 0.1 to 0.3%. The energies and relative intensities of the electron groups were determined. The lack of data on the intensities of γ rays allowed multipolarity assignments to be made only for the 133.1-, 171.5-, and 268.3-keV transitions in ^{182}Ta. Spin-parity assignments were made for a few levels in ^{182}Ta. A level scheme is proposed for ^{182}Ta. NSA

N68-33194# Michigan Univ., Ann Arbor.
A MEASUREMENT OF THE FINE AND HYPERFINE STRUCTURES OF THE 2 3P STATES OF HELIUM 3
Kenneth Raye Garman (Ph.D. Thesis) 1967 107 p refs
(Contract AT(11-1)-1112)
(COO-1112-156) CFSTI: HC $3.00/MF $0.65

This study reports on an experimental determination of the fine and hyperfine structures of the 2^3P term of ^{3}He. The technique used was that of level-crossover spectroscopy. In this method the change of the angular distribution of the resonance fluorescence of atoms in a magnetic field when two excited state Zeeman sublevels cross is used to perform a measurement of the crossover field. Eighteen crossovers were observed and ten of these were measured to an accuracy of a few parts per million. The crossover signals were corrected for an asymmetry that arose from both improper optical alignment and the finite sizes of the source and detector. In addition six of the crossovers were investigated for any systematic dependence on pressure, light intensity and discharge intensity, but no shifts were found to an accuracy of about a part per million. The hyperfine constants and g value were calculated from the measured crossover fields, but not to the accuracy to which the fields could be measured. Author (NSA)

N68-33209# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy.
REGENERATION PROCESS $K^0_L \rightarrow K^0_S$ AT HIGH ENERGIES [PROTSESS REGENERATSII $K^0_L \rightarrow K^0_S$ PRI BOL'SHIKH ENERGIYAKH]
E. Okonov 1968 12 p refs In RUSSIAN
(JINR-P1-3788)

It is suggested to use $K^0_L \rightarrow K^0_S$ regeneration at high energies for investigation of the asymptotic behavior of imaginary and real parts of KNand KN-scattering amplitudes, for the search of "strange" baryon resonances and for the determination of electromagnetic K^0 meson dimensions. Author (NSA)

N68-33210# Michigan Univ., Ann Arbor.
LONG RANGE ELECTROSTATIC AND ELECTROMAGNETIC INTERACTIONS BETWEEN ATOMS
Jose Luis Martinez Cortez (Ph.D. Thesis) 1967 219 p refs
(Contract AT(11-1)-1112)
(COO-1112-160) CFSTI: HC $3.00/MF $0.65

Nondegenerate perturbation theory is used to calculate the contribution to the interaction energy between two neutral hydrogenic atoms in the ground state due to their electrostatic interaction and the presence of an electromagnetic field in the system. Casimir and Polder have treated this problem to first order in both the electrostatic interaction potential and the radiation field (dipole–dipole approximation). Their results are verified in this calculation and extended beyond the dipole approximations to obtain interaction energies accurate to quadrupole–quadrupole orders. Corrections are obtained for each of the dipole–dipole, dipole–quadrupole, and quadrupole–quadrupole electrostatic energies. In addition, a systematic analysis is performed to determine the coupling between the electrostatic interaction and the electromagnetic potential to give rise to the retardation contribution to the interaction energy of the system. NSA

N68-33216 European Organization for Nuclear Research, Geneva (Switzerland).
THE QUARK HUNTERS' PROGRESS
T. Massam 8 Jul. 1968 34 p refs Lectures given in the Acad. Training Programme of CERN, Geneva, 1968
(CERN-68-24)

Lectures are presented of experiments which were carried out to search for any particles which might belong to one of the sets of particles proposed as the basic constituents of the elementary particles. Particles with either fractional or integral charge and of any mass will be considered. The search is really for unknown particles with almost unknown properties. The most popular method of measuring the charge has been by specific ionization measurements in counter work and in bubble-density measurements in bubble chambers. Velocity spectra have been measured in secondary beams from machines and in cosmic rays in order to detect anomalous mass values with integral or non-integral charges. Direct charge measurements have been made using optical and mass spectroscopy, and also by the Millikan and the magnetic levitometer methods. Author

N68-33221*# Naval Ordnance Test Station, China Lake, Calif. Michelson Lab.
DIFFRACTION OF INELASTICALLY SCATTERED ELECTRONS IN TUNGSTEN AT LOW ENERGIES

J. O. Porteus [1967] 20 p refs Presented at the 4th Intern. Mater. Symp., Berkeley, Calif., 19-21 Jun 1968
(NASA Order R-05-030-001)
(NASA-CR-96376) CFSTI: HC $3.00/MF $0.65 CSCL 20H

A study on a clean tungsten (110) surface of the angular and energy dependence of electron scattering by plasmons near 100 eV shows well defined diffracted beams of inelastic electrons. The positions of these beams relative to diffracted elastic beams suggests that plasmon scattering and diffraction are not independent. Intensity vs. voltage maxima for the inelastic beams agree in most cases with those for corresponding elastic beams, although some differences are apparent. Possible application of results include studies of electron-plasmon interaction phenomena and additional information on LEED interpretations. Author

N68-33248 Rochester Univ., N. Y.
A COMPOSITE MODEL OF THE Σ HYPERON
Anna J. Calpacas (Ph.D. Thesis) 1967 196 p
Available from Univ. Microfilms: HC $9.00/MF $3.00 Order No. 67-13615

A simple composite picture for the Σ hyperon is considered. The Σ is taken to be a mixture of bound Λπ and NK pairs. The other fundamental assumptions of the model are the validity of unsubtracted dispersion relations for composite vertices with an elementary particle off the mass shell and of a ladder approximation to the Bethe-Salpeter equation. The model only attempts to determine gross features of the Σ, since the approximations made do not do justice to the detailed structure of the particle. Dissert. Abstr.

N68-33249# Polish Academy of Sciences, Warsaw.
LOW ENERGY SUM RULES IN NON-FORWARD DIRECTION [NISKOENERGETYCZNE REGULY SUMACYJNE DLA NIEZEROWEGO PRZEKAZU PEDU]
M. Swiecki 1968 11 p refs
(Rept.-896/VII/PH) CFSTI: $3.00

The low energy sum rules for $t \neq 0$ have been derived. As an example the sum rule connecting the electromagnetic form factors of nuclear and pion-nucleon phase-shifts has been presented. Saturation of this last sum rule for $t=0$ with N^* only gives reasonable numbers for the isovector magnetic moment of the nucleon. Author

N68-33251# California Univ., Berkeley. Lawrence Radiation Lab.
UNITARITY AND FINITE ENERGY SUM RULES
Farzam Arbab (Ph.D. Thesis) 21 Apr. 1968 37 p refs
(Contract W-7405-ENG-48)
(UCRL-18232)

Unitarity, analyticity, Regge asymptotic behavior, and a resonance approximation are combined to derive a new sum rule. The sum rule is very convergent: the contribution of high-mass resonances is suppressed by a decreasing weight function. The spin-flip and nonspin-flip residues of the ρ meson in the $\pi\pi \to N\bar{N}$ amplitude are evaluated at the mass of the ρ, and in conjunction with the first-moment finite-energy sum rule a calculation of the ρ-meson mass is performed. The results are in good agreement with experiment. The sum rule is then applied to the calculation of the ρ and f_0 resonance parameters in the $\pi\pi \to \pi\pi$ amplitude. A discussion of the behavior of the sum rule near the elastic threshold is also included. This discussion may give some insight into the nature of the approximations involved in the derivation of the sum rule. Author (NSA)

N68-33295# Polish Academy of Sciences, Warsaw.
ESTIMATION OF FOUR-MOMENTUM TRANSFER AND EFFECTIVE MASS IN COHERENT INTERACTIONS OF 200 GEV PIONS WITH EMULSION NUCLEI [OCENA PRZEKAZANEGO CZTEROPEDU I EFEKTYWNEJ MASY W KOHERENTNYCH ODDZIALYWANIACH PIONOW O SREDNIEJ ENERGII 200 GEV Z JADRAMI EMULSJI]
O. Czyzewski and K. Rybicki 1968 10 p refs Submitted for publication
(Rept.-888/VI/PH) CFSTI: $3.00

Four-momentum transfer and effective mass have been estimated in coherent interactions of 200 GeV pions with emulsion nuclei. The results which are very similar to those at machine energies represent an additional evidence that these are really coherent events. It seems from all data that the cross section for coherent production increases with the increase of primary energy. Author

N68-33299# Polish Academy of Sciences, Cracow.
STUDY OF THE (d,p) REACTION ON Ti^{48} AND Ti^{50} NUCLEI [REAKCJE TYPU (d,p) NA JADRACH Ti^{48} I Ti^{50}]
K. Grotowski, A. Jasielska, T. Panek, F. Pellegrini, and S. Wiktor Mar. 1968 24 p refs
(INP-594/PL)

Proton spectra from $^{48}Ti(d,p)^{49}Ti$ and $^{50}Ti(d,p)^{51}Ti$ reactions at the incident deuteron energy of 12.9 MeV were measured in wide range of angles. Six proton groups leading to ground, 1.38, 1.72, 2.50, 3.26, and 3.80 MeV states of the ^{49}Ti nucleus and two proton groups leading to ground and 1.16 MeV states of the ^{51}Ti nucleus were taken for the analysis of angular distributions. The distorted-wave, zero-range Born approximation method was applied; and the l-values, as well as spectroscopic factors corresponding to different transitions, were obtained. Four different sets of parameters of the deuteron optical potential were used in the DWBA analysis, and their influence on the shape of angular distributions and the magnitude of the spectroscopic factors was investigated. Only these potentials which have the depth of the real potential not lower than about 100 MeV appeared to be acceptable. In the angular distributions measured, noticeable effects due to different coupling of spin and orbital angular momentum of the transferred neutron were observed. The differences in shapes of angular distributions caused by that effect were related to the polarization of protons scattered elastically on Ti nuclei. Author (NSA)

N68-33320# Stanford Linear Accelerator Center, Calif.
FORWARD PHOTOPRODUCTION OF VECTOR MESONS FROM HYDROGEN AT ENERGIES FROM 6.5 GeV TO 17.8 GeV
W. G. Jones (Calif. Inst. of Tech., Pasadena), D. Kreinick (Calif. Inst. of Tech., Pasadena), R. Anderson, D. Gustavson, J. Johnson et al Jun. 1968 11 p refs Sponsored by AEC
(SLAC-PUB-439)

We report measurements of the differential cross sections of ρ^0 and ϕ meson photoproduction on hydrogen for a range of four-momentum transfer squared, t from $-0.2(GeV/c)^2$ to $-0.9(GeV/c)^2$, and a range of incident photon energies from 6.5 GeV to 17.8 GeV. It was found that differential cross sections obtained for ρ^0 production are in good agreement with the vector dominance model. Author

N68-33368# New York Univ., N. Y. Dept. of Physics.
RELATIVISTIC AND ONE-PROTON CORRECTIONS TO THE INTERACTION BETWEEN TWO ATOMIC SYSTEMS
James F. Walker, Jr. May 1968 75 p refs
(Contract Nonr-285(58))
(TR-N89-1; AD-671839)

The problem of photon exchange and relativistic corrections to atomic and molecular states has previously been treated quite extensively for individual atoms and molecules. The theory is now developed for including one-photon exchange effects and the leading relativistic corrections to low energy ion-ion scattering problems. The

technique used is based on the Born-Oppenheimer approximation yielding an effective interatomic potential between the atoms. A projection operator technique is used to reduce the problem from the starting point of relativistic quantum electrodynamics to the final effective potential, which depends only on the interatomic coordinate and on the atomic spin operators. The asymptotic form for the potential is developed explicitly for the case of S-state atoms. TAB

N68-33376*# Oak Ridge National Lab., Tenn. Neutron Physics Div.

ANALYTIC REPRESENTATION OF NUCLEON AND PION-EMISSION SPECTRA FROM NUCLEON-NUCLEUS COLLISIONS IN THE ENERGY RANGE 750–2000 MeV

R. G. Alsmiller, Jr., and J. Barish 1 Jul. 1968 75 p refs
(NASA Order R-104(1))
(NASA-CR-96371; ORNL-TM-2277) CFSTI: $3.00 CSCL 20H

Tabulated data are given on the nonelastic cross section and the energy and angular distribution of emitted neutrons and protons when neutrons in the energy range of 1000 MeV and protons in the energy range of 750, 1000, and 2000 MeV are incident on oxygen, aluminum, and lead targets. Analytical expressions are given for (1) the cascade neutron-, proton, π^+-, π^0-, and π^--emission spectra in the laboratory angular intervals 0–30°, 30–60°, 60–90°, 90–180°, and 0–180°, and (2) the evaporation neutron- and proton-emission spectra. B.S.D.

N68-33387 Rice Univ., Houston, Tex.

MICROWAVE RADIATION OF SINGLY CHARGED HELIUM 3 FROM H II REGIONS

Henry Crawford Goldwire, Jr. (Ph.D. Thesis) 1967 169 p
Available from Univ. Microfilms: HC $7.80/MF $3.00 Order No. 67-13074

The hyperfine structure of the ground state of singly charged helium 3 is considered in detail. The frequency of a photon emitted in a hyperfine transition from the singlet state to the triplet state is calculated to be 8,665,649,900 ± 1900 Hz, a value which compares favorably with an observed value. The corresponding Einstein coefficient is determined to be 1.950×10^{-12} sec^{-1}, indicating that the lifetime of the upper hyperfine state against spontaneous emission of 3.46-cm radiation is about 16000 years. The possible abundance of He^3 in the interstellar medium is discussed and some of the important questions that may hinge upon this abundance are delineated. It is argued that in H II regions, He^3 will exist primarily as He^3II in the ground state. From considerations of the electron collisional cross section for deexcitation of the singlet hyperfine component of the He^3II ground state, the spin temperature of He^3II in H II regions is shown to be equal to the kinetic temperature. Dissert. Abstr.

N68-33423 State Univ. of New York at Buffalo.

A STUDY OF METHODS FOR CALCULATING THE SPIN-ORBIT DOUBLET SPLITTING IN O^{17}

Walter Kenneth Niblack (Ph.D. Thesis) 1967 150 p
Available from Univ. Microfilms: HC $7.00/MF $3.00 Order No. 67-13355

The purpose of this dissertation was to develop improved methods for calculating the properties of light nuclei, using as a starting point the assumption that they consist of a known number of nucleons, interacting by means of a known two-body potential. Two approaches are investigated. The first involves the solution of the equation for the motion of two nucleons in a common harmonic oscillator well, interacting by means of a hard core only. This method is illustrated by calculating the spin-orbit splitting in O^{17}, using the phenomenological potential of Gammel and Thaler, with results in close agreement with the experimental value of 5.1 MeV. The second method circumvents the hard-core problem, and also the usual expansion of the K-matrix into terms of various orders in the potential. V, by use of a new method for approximating particular eigenvalues and eigenfunctions of a Hamiltonian. Dissert. Abstr.

N68-33424# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Reactions.

EXPERIMENTS ON SEARCH FOR α-RADIOACTIVE ISOTOPES OF ELEMENT (105) [EKSPERIMENTY PO POISKU α-RADIOAKTIVNYKH IZOTOPOV 105 ELEMENTA]

G. N. Flerov, V. A. Druin, and A. G. Demin 1968 16 p refs In RUSSIAN
(JINR-P7-3808)

Experiments in the search for the α-emitting isotopes of element 105 are described. The short-lived α emitters with α-particle energies of 9.4 and 9.7 MeV were synthesized by bombarding ^{243}Am with the ^{22}Ne ions. It is shown that by its decay α emitters are produced, the properties of which are similar to those of the 256, 257103 isotopes. A preliminary conclusion was drawn that 9.4- and 9.7-MeV α emitters are the element-105 isotopes. Author (NSA)

N68-33448# Paris Univ., Orsay (France). Laboratoire de Physique Theorique et Hautes Energies.

ON THE FUNCTIONAL FORMALISM IN QUANTUM FIELD THEORY

M. Dubois-Violette Mar. 1968 13 p refs
(LPTHE-TH-68/6)

A formalism is developed to deal with c-number generating functionals of quantum field theory. The general unitary relations and Schwinger equations are investigated using this formalism. Then, the formalism is used to construct a functional formulation of quantum field theory, in which state vectors are described by functionals, and field operators by functional differential operators. This formulation is in complete analogy with the wave-mechanics formulation of nonrelativistic quantum theory, in which state vectors are described by functions and observables by differential operators. Finally the case of the electromagnetic field is investigated. This framework leads to a great unification of the functional formalism and simplifies the explicit calculations in many cases. Author (NSA)

N68-33459 Cornell Univ., Ithaca, N. Y.

MEASUREMENT OF THE PION FORM FACTOR BY COINCIDENCE ELECTROPRODUCTION

William Wesley Ash (Ph.D. Thesis) 1967 147 p
Available from Univ. Microfilms: HC $7.00/MF $3.00 Order No. 67-16354

Using the internal circulating beam of the Cornell 2.2 GeV electron synchrotron and a liquid hydrogen target, the reactions of pion electroproduction were studied. Using two quadrupole magnets with counter telescopes the final electron and charged nucleon/pion were momentum analysed and detected in coincidence. This overdetermination of the kinematics allowed a substantial reduction in the background that has hampered other efforts. Accurate measurements of the cross section were made at pion-nucleon center of mass angles of 0° and 180°, c.m. energies of 1175, 1200, and 1300 MeV, and four momentum transfers of 1, 3, 1, and 8 F^{-2}. The pion form factor agrees best with the nucleon form factor behavior, but is not in unreasonable disagreement with that predicted by rho exchange. The extracted rms radius of the pion is found to be .75 ± .1 Fermis. Dissert. Abstr.

N68-33465 Minnesota Univ., Minneapolis.

P, π REACTIONS IN LIGHT NUCLEI AT 40 MeV

Vladimir Shkolnik (Ph.D. Thesis) 1967 178 p
Available from Univ. Microfilms: HC $8.20/MF $3.00 Order No. 67-14651

In order to study the usefulness of the (p,α) reaction as a tool in nuclear spectroscopy, a limited survey was made of this reaction involving light nuclei, and at incident proton energy of 40 MeV. Targets containing C^{12}, N^{14}, O^{16}, F^{19}, Ne^{20}, Mg^{24}, and Al^{27} were exposed to the proton beam from the University of Minnesota Linear Accelerator; the reaction products were momentum-analyzed by the 40 inch magnetic spectrometer, and detected in its focal plane by the 32-detector solid-state array. Alpha particles were identified by their specific energy loss, and their spectra plotted. Angular distributions and/or absolute differential cross-sections were measured for angles between 10° and 60° in the laboratory system. The upper limit in the angular range was determined by the beam intensity, which also set the overall resolution limit for the analyzing system at about 400 keV, i.e., states closer than that in excitation could not be separated. Dissert. Abstr.

N68-33491# Rome Univ. (Italy).
FINITE ENERGY SUM RULES FOR PION PHOTOPRODUCTION AND THE OMEGA-REGGE POLE RESIDUE FUNCTIONS
P. Di Vecchia, F. Drago, and M. L. Paciello 16 Jan. 1968 27 p refs *Its* Nota Interna No. 150
(NP-17489)

The behavior of the ω residue functions in pion photoproduction is studied. It is shown that they have no zeros at $t \cong -0.15$ $(GeV/c)^2$; this is in striking contradiction with the usual explanation of the crossover phenomena. The behavior of the ω trajectory near the wrong signature nonsense point $\alpha = 0$ was investigated. The usual theory of the dip seems to work well and suggests that unlike the ρ, the ω trajectory is nonsense choosing. Author (NSA)

N68-33492# Rome Univ. (Italy).
FINITE ENERGY SUM RULES AND THE CROSSOVER PROBLEM IN K-N SCATTERING
P. Di Vecchia, F. Drago, and M. L. Paciello 6 Feb. 1968 13 p refs *Its* Nota Interna No. 156
(NP-17490)

The behavior of the ω-residue functions in kaon-nucleon elastic scattering is studied using the finite energy sum rules technique. It is found that both spin flip and nonspin flip ω-residues show a zero near $t \approx -0.1$ $(GeV/c)^2$; this is in agreement with the usual explanation of the crossover phenomena in KN and NN elastic scattering, but in contradiction with the behavior of the ω-residue functions deduced from other reactions. Author (NSA)

N68-33519 Northwestern Univ., Evanston, Ill.
APPROXIMATE SOLUTIONS TO THE SCHROEDINGER EQUATION FOR THE ELECTRONIC ENERGIES OF ONE, TWO, AND THREE-ELECTRON MOLECULES
Edward Shaffer Martin (Ph.D. Thesis) 1967 135 p
Available from Univ. Microfilms: HC $8.40/MF $3.00 Order No. 67-15288

Approximate solutions to the Schrödinger equation for small molecular systems use a one-center expansion method to calculate the energy of some one, two and three-electron molecular systems. This method was characterized by the use of only one exponential parameter in the basis functions in contrast to the usual practice of using a different exponential parameter for each angular type of basis function. This has the effect of permitting the storage on tape of all matrices except the one dependent upon internuclear distances and exponential parameter (the matrix for the off-center potential). The results of H_2^+ were a total energy of −1.098271 hartrees with thirty terms centered on the mid-point of the internuclear axis with an internuclear distance of 2.00 bohrs, compared with the exact value E = −1.10263 hartrees at that internuclear distance. Dissert. Abstr.

N68-33525*# State Univ. of Iowa, Iowa City. Dept. of Physics and Astronomy.
THE EFFECT OF BULK MOTION ON THE SYNCHROTRON RADIATION RATE
Peter D. Noerdlinger Jul. 1968 8 p refs
(Grant NsG-233)
(NASA-CR-96471; Rept.-68-42) CFSTI: HC $3.00/MF $0.65 CSCL 20H

Calculating the power emitted in the center of the momentum system and then transforming this result into the laboratory system is considered the surest way to obtain the proper synchrotron radiation rate for an ensemble of relativistic particles in bulk or mean motion. Scheuer asserts that the apparent luminosity of any synchrotron-radiating source can be found by multiplying the power per electron by the mean number of electrons in the source with appropriate pitch angle to radiate toward the observer. This rule is considered valid for steady sources that do not move, but two examples are cited for which it fails. One case is that of an isotropic distribution of electrons in a tangled magnetic field, the whole in motion; while the second is a model for a quasi-stellar source. M.W.R.

N68-33547# Nuklearni Institut Jozef Stefan, Ljubljana (Yugoslavia).
RADIATIVE CAPTURE OF 14.1 MeV NEUTRONS AND THE DIPOLE GIANT RESONANCE [RADIATIVNO ZAJETJE NEVTRONOV ENERGIJE 14.1 MeV IN DIPOLNA VELERESONANCA]
A. Hudoklin-Bozic Jan. 1968 62 p refs In YUGOSLAV
(NIJS-P-213)

The measurements of gamma-ray spectra from the radiative capture of 14.1-MeV neutrons by nuclei ^{28}Si and ^{40}Ca are described. The spectra show a certain gross structure similarly as the spectra of other nuclei measured previously. For the integral cross section the following values were obtained: $\delta_{int,Si} = 0.44$ mb ± 0.09 mb and $\delta_{int,Ca} = 0.50$ mb ± 0.10 mb. Both values follow a relatively smooth dependence of the integral cross section on the mass number obtained from earlier measurements. Calculation of gamma-ray spectra on the basis of three different approaches to the direct-semidirect theory, supposing the formation of dipole resonance states in the reaction process, is described. Results are given for target nuclei ^{28}Si, ^{32}S, ^{40}Ca, ^{52}Cr, and ^{56}Fe. The calculated spectra are compared with the experimental data. Author (NSA)

N68-33548*# Maryland Univ., College Park. Physics and Astronomy Dept.
A PROGRAM TO CALCULATE PARTICLE SPECTRA PRODUCED IN HIGH ENERGY PROTON-PROTON COLLISIONS BY THE TWO-TEMPERATURE STATISTICAL MODEL
J. R. Wayland Jun. 1968 19 p
(Grant NGL-21-002-033)
(NASA-CR-96317; TR-844) CFSTI: $3.00 CSCL 20H

It is pointed out that the main assumption of the two-temperature model is that there are two characteristic temperatures associated with each type of particle produced. The transverse momentum distribution (T_0) describes the natural thermal motion of a hot interaction region, and gives a transverse momentum distribution independent of the incident energy. However, T_0 will be different for different mass particles. The longitudinal momentum distribution (T) is considered as the quasi-equilibrium condition at which the various particles boil off as the interaction volume cools; T is greater than T_0 as it includes the effect of the collective motion of the interacting gas along the direction of the incoming nucleon. The input parameters for the FORTRAN program are listed, and the values of the fixed parameters for the π+, π−, K+, K−, p, and p̄ spectra are given. Also listed is the program for computing energies greater than 1000 GeV. M.G.J.

N68-33557 California Inst. of Tech., Pasadena.
EXPERIMENTAL STUDY OF ANTIPROTON–PROTON ANNIHILATION INTO AN ELECTRON–POSITRON PAIR AND ANTIPROTON–PROTON ANNIHILATION INTO TWO γ-RAYS FOR INCIDENT ANTIPROTON MOMENTA OF 1.50 GEV/C AND 2.50 GEV/C
Donald LeRoy Hartill (Ph.D. Thesis) 1967 199 p
Available from Univ. Microfilms: HC $9.00/MF $3.00 Order No. 67-14349

Upper limits for the differential cross sections at 90° in the center of mass system for the reaction $\bar{p}+p \rightarrow e^+ + e^-$ have been measured for incident antiproton momenta of 1.50 GeV/c and 2.50 GeV/c. These limits of the 90% confidence level were 1.8 ± 10^{-34} cm^2/st and 4.2 ± 10^{-35} cm^2/st. respectively. Two thin foil spark chambers were used to measure the laboratory angles of the electron and positron and two lead plate spark chambers were used to identify the electron and positron by their characteristic electromagnetic showers produced in such chambers. Assuming a one photon exchange mechanism for the annihilation, upper limits equal to 0.2 if $|G_E| = |G_M|$ for the electric and magnetic form factors of the proton for time-like momentum transfers of +5.1 $(GeV/c)^2$ and +6.8 $(GeV/c)^2$ were obtained from the cross section limits. Dissert. Abstr.

25 PHYSICS, PLASMA

Includes magnetohydrodynamics. For applications see: 28 Propulsion Systems.

N68-32279# Institut fur Plasmaphysik G.m.b.H., Garching (West Germany).
A SYSTEM OF SUPERCONDUCTING COILS 5 CM, 17 CM AND 35 CM IN DIAMETER
B. Oswald, W. Amenda, P. Krueger, H. Lohnert, and P. Mayer Jun. 1968 17 p
(IPP-4/60) CFSTI: HC $3.00/MF $0.65

To determine the feasibility of applying large superconducting coils in plasma physics experiments, module-type standard coils were developed and tested. Three different coil types were combined to form variable field geometries. The maximum field achieved was about 100 KG. Test results are compared with short sample characteristics of superconducting materials, such as Nb_3Su tape and NbTi composite cable. Author

N68-32280# Institut fur Plasmaphysik G.m.b.H., Garching (West Germany).
GENERATION OF RAPID RISE CURRENT PULSES IN THE MSEC RANGE FOR FAST COMPRESSION EXPERIMENTS
A. Knobloch and G. Herppich Jun. 1968 48 p refs Presented at the 5th Symp. on Fusion Technol., Oxford, 2–5 Jul. 1968
(IPP-4/57) CFSTI: HC $3.00/MF $0.65

In the field of shock heating and fast compression experiments it was considered worthwhile to increase the length of discharge vessels by about one order of magnitude. To optimize the lumped parameter capacitive energy storage systems for such applications, the design considerations were extended. Assuming certain practical geometric arrangements and that the voltage dependence of the several components is linear in a limited range, an equation for the primary bank generating the rapid rise was derived. Relations for the determination of capacitor bank components as well as physical dimensions, numbers, and storage costs are also given. The conditions for producing relatively long current pulses with the same coil which generates the rapid rise were investigated. Relations which determine the data of the constant current source in terms of the optimized primary bank were derived. The form of the constant current must be chosen according to the conditions of the special case. Some possibilities are discussed. Author

N68-32283# Grumman Aircraft Engineering Corp., Bethpage, N. Y. Research Dept.
ELECTROSTATIC PROBE MEASUREMENTS IN A PARTIALLY IONIZED FREE JET FROM A SONIC ORIFICE
Richard C. Jenkins Jul. 1968 74 p refs
(RE-333)

This report describes an investigation in a low density flow of partially ionized argon produced by an arc jet. Transient probe techniques were used to obtain free stream measurements with both Langmuir and floating double probes. Flow surveys were made to determine variations of electron temperature and ion density in various regions of the flow. The ion density variation along the centerline agreed with that predicted analytically, but the absolute level was higher than predicted. Probe measurements showed that this absolute level was strongly influenced by arc operating conditions. In addition to steady state flows, both unsteady and turbulent flows were produced to determine the effects of fluctuations of free stream properties on electrostatic probe measurements. Author

N68-32284*# Cornell Aeronautical Lab., Inc., Buffalo, N. Y.
SHOCK-TUBE STUDIES OF N+ AND O+ RECOMBINATION RADIATION IN THE VACUUM ULTRAVIOLET Final Report
Paul V. Marrone, Walter H. Wurster, and John E. Stratton Jun. 1968 105 p refs
(Contract NASr-119)
(NASA-CR-96235; CAL-AG-1729-A-7) CFSTI: HC $3.00/MF $0.65 CSCL 20I

Spectrally resolved vacuum UV radiation measurements of the continuum arising from the recombination of electrons with N+ and O+ ions were made in a high-purity shock tube. Mixtures of neon and nitrogen or oxygen were used. The radiation was observed behind the reflected shock wave at 11,000°K to 13,000°K. Since this radiation occurs at wavelengths less than 1100 Å, the use of windows is precluded. An explosively driven windowless plunger couples the shock tube to a vacuum UV spectrometer with three bare stainless steel photomultiplier detectors. The plunger-detector system, the purity level of the gas handling system, the long ionization relaxation times of N_2 and O_2 heavily diluted with neon, and the effects of non-equilibrium on the state of the gas are discussed. The shocked gas in the experiments ranged from optically thin to blackbody conditions. Photoionization cross sections for both N and O were obtained; they compare favorably with theoretical calculations. Author

N68-32287# Institut fur Plasmaphysik G.m.b.H., Garching (West Germany).
PRECISE MEASUREMENT OF HF FIELDS IN MODELS
G. Herppich and J. Mantel May 1968 47 p refs Presented at the 5th Symp. on Fusion Technol., Oxford, 2–5 Jul. 1968
(IPP-4/51) CFSTI: HC $3.00/MF $0.65

To gain performance and stability in plasma heating devices, an exact h.f. field distribution and homogeneity must be determined. The calculation of the field distribution in complex geometry turned out to be very cumbersome. Measuring methods with high accuracy and stability for sine waves and pulses are demonstrated and analysed. Author

N68-32301# Institut fur Plasmaphysik G.m.b.H., Garching (West Germany).
CAPACITOR BANKS FOR A TURBULENCE HEATING EXPERIMENT

G. Herppich, A. Knobloch, and G. Mueller Jun. 1968 44 p refs Presented at the 5th Symp. on Fusion Technol., Oxford, 2–5 Jul. 1968
(IPP-4/50) CFSTI: HC $3.00/MF $0.65

A fast main bank for a turbulence heating experiment has already been designed for multipurpose application. This bank was operated at 40 kV. It has now been subdivided into a preionization and a compression bank. The compression bank stores 8 kJ at 40 kV and delivers 554 kA with a rise time of 570 nsec. The bank is connected by sandwich conductors to a symmetrically double-fed linear coil. The coil length 60 cm is equal to the collector width; the coil diameter is 15.8 cm. Special components of the bank system are the collector system, the pressurized combined start and crowbar spark gaps, and the suppressor units at the collector for reducing line reflections. One-sixth of the former main bank was sliced off as a theta pinch preionization bank. The data are 1.6 kJ, 40 kV, 813 kHz. To avoid faulty ignition of the spark gaps by voltage pulses coming from the preionization bank, suppressors were connected at the spark gaps of the main bank. Author

N68-32305# Army Electronics Command, Fort Monmouth, N. J.
PLASMA SHEATH DIODE
Maurice Weiner and Robert True Jun. 1968 43 p refs
(ECOM-2976; AD-671599)

Microwave nonlinear effects were observed in the plasma sheath surrounding a probe. Results were obtained for a PIG discharge operating at 1.0 to .02 torr xenon. The nonlinear effects include mixing, harmonic generation, and current rectification. The probe is connected directly to a 50-ohm coaxial transmission line through which the microwave signal is coupled to the sheath. Strong nonlinear interaction is observed when the probe is dc biased at a point in the exponential region of the electrostatic curve. The nonlinear interaction occurs largely inside the microwave absorption bands found in the 1.0 to 2.0 GHz range. The center frequency of the absorption band corresponds to the resonant frequency of the sheath-plasma system and is somewhat lower than the plasma frequency. Author (TAB)

N68-32321 Pennsylvania Univ., Philadelphia.
ON THE ROTATION OF CONDUCTING FLUIDS DUE TO CROSSED ELECTRIC AND MAGNETIC FIELDS WITH SECONDARY FLOWS
Peter Cheng-kang Hsueh (Ph.D. Thesis) 1967 135 p
Available from Univ. Microfilms: HC $6.40/MF $3.00 Order No. 67-12754

Applied and induced electromagnetic forces are used to drive an incompressible, constant-viscosity, electrically conducting fluid, confined between two concentric cylinders. Small magnetic Reynolds number and a negligible Hall effect are assumed to analyze the three dimensional laminar flow phenomena, heat transfer effect, and effects of the induced fields. Analytic solutions are obtained for three cases: 1. The flow field in an infinitely long cylinder. The energy storage and ultimate flow velocity reach their maximum when the Hartmann number is comparable to the first eigenvalue. 2. The flow field in a finite cylinder. It is found that when the cylinder's length is greater than the gap, end effects can be neglected. 3. Effects of induced body forces in a finite cylinder are studied using a perturbation technique. Results show that secondary flow will be generated in the direction perpendicular to the primary flow. Dissert. Abstr.

N68-32356# Institut fur Plasmaphysik G.m.b.H., Garching (West Germany).
PRESSURIZED TWO-ELECTRODE SPARK GAP WITH SATURABLE INDUCTANCE. PART 2: PULSE BREAKDOWN, ARC MIGRATION, AND SPARK GAP DATA
E. v. Mark and H. Wedler Jun. 1968 57 p refs
(IPP-4/55, Pt. 2) CFSTI: HC $3.00/MF $0.65

Pulse breakdown voltage is investigated in pressurized air. The influence of irradiation, voltage and field strength gradient, pressure and gap distance are studied. The results show good agreement with calculations. Experiments with a 40 kJ standard unit are conducted to clarify problems such as arc migration and minimum electrode distance. Experiments are started now, to test the first prototype of an overvolted two electrode gap. Jitter and delay time curves from the first measurements are discussed. Author

N68-32357# Institut fur Plasmaphysik G.m.b.H., Garching (West Germany).
PRESSURIZED TWO-ELECTRODE SPARK GAP WITH SATURABLE INDUCTANCE. PART 1: EXPERIMENTS WITH VARIOUS FERRITE MATERIALS
E. v. Mark and H. Wedler Jun. 1968 33 p refs
(IPP-4/54, Pt. 1) CFSTI: HC $3.00/MF $0.65

Initial results in developing a compact pressurized two electrode spark gap with saturable inductance for heavy duty are given. The first part of the paper describes experiments with various ferrite cores and ferrite materials. The maximum attainable voltage is defined as a function of the pulse steepness, the ferrite material, and the saturated inductance L_{Fe_0}. In the second part the pulse breakdown voltage is investigated in pressurized air. The results show good agreement with calculations. Experiments with a 40 kJ standard unit are conducted to clarify problems such as arc migration and minimum electrode distance. Author

N68-32358# Institut fur Plasmaphysik G.m.b.H., Garching (West Germany).
A MODEL FOR THE IONIZATION OF A HYDROGEN GAS BY OHMICLY HEATED ELECTRONS
W. Koeppendoerfer Mar. 1968 31 p refs
(IPP-1/79) CFSTI: HC $3.00/MF $0.65

For the purpose of supporting the experimental work in ionizing a hydrogen or deuterium gas by high current discharges, a simple model is presented which describes the ionization by ohmicly heated electrons. Simple scaling laws are introduced by normalizing the equations with respect to the filling density. This is possible if the considerations are restricted to a density region where binary collisions prevail and if homogeneity of the plasma is assumed. The results provide values for the minimum current density necessary to ionize the gas in a certain time and for a given filling density. Author

N68-32369# Institut fur Plasmaphysik G.m.b.H., Garching (West Germany).
ON THE APPLICABILITY OF THE LINE REVERSAL METHOD FOR MEASURING THE ELECTRON TEMPERATURE IN A WEAKLY IONIZED ALKALI SEEDED RARE GAS PLASMA
G. Brederlow, W. Riedmueller, and M. Selvat Feb. 1968 35 p refs
(IPP-3/69) CFSTI: HC $3.00/MF $0.65

When an electric current is passed through an alkali seeded rare gas plasma the electron temperature rises above the gas temperature. This effect was investigated in a streaming argon–potassium plasma at atmospheric pressure and a gas temperature of 2000°K. To measure the electron temperature the applicability of the line reversal method was investigated. General conditions under which the electron temperature equals the line reversal temperature were derived. In the case studied, the plasma had to be optically thick to the resonance radiation used. The electron temperature was measured with this method as a function of the current density. The results were compared with the values calculated from the theory and those calculated from the measured conductivities. For electron temperatures above 2400°K all three give the same results. Author

N68-32370# Institut fur Plasmaphysik G.m.b.H., Garching (West Germany).

INVESTIGATION FOR THE USE OF LECHER WIRE METHOD FOR THE MEASUREMENT OF IONIZATION RATE IN SHOCK HEATED GASES [UNTERSUCHUNGEN ZUR ANWENDUNG EINER LECHERDRAHT-MIKROWELLENMETHODE FUER DIE MESSUNG DER IONISATIONSRATE IN STOSSWELLENGEHEIZTEN GASEN]

A. Siddiqui Mar. 1968 35 p refs In GERMAN; ENGLISH summary

(IPP-3/70) CFSTI: HC $3.00/MF $0.65

The ionization rate in shock heated gases, i.e. the variation of electron density with time can be measured with microwave methods. The microwave method developed in 4 mm region by Makios for similar measurements at a T-tube are found very suitable for the present measurements. In this method microwave power is coupled to a two wire system, which is stretched through the plasma. It has the advantage of having high spatial resolution. The advantages and the disadvantages of this method were investigated and coupling systems for wave transformation having low losses were developed. The energy distribution around the wires of different diameter and having different parting distance between them was calculated for the quantitative study of spatial resolution. Almost all the energy flows through a ring having 1 mm radius around the axis of a wire. Due to hypersonic flow detached bow shock waves are produced which are 1 mm apart from the wire. Hence practically only the region behind the bow shock would be measured. This restricts the accuracy of the method to perhaps a factor of two. The wires used here have 0.3 mm diameter and were 4 mm apart and these dimensions happen to be the same as those in a probe method successfully used by Hobson for measurements at shock tube. The advantages and disadvantages of their method are similar to that described here as well as the accuracy. Author

N68-32381# Institut fur Plasmaphysik G.m.b.H., Garching (West Germany).

THE NONLINEAR INTERACTION OF A STEADY-STATE CIRCULARLY POLARIZED ELECTROMAGNETIC WAVE WITH A COLD PLASMA IN A CONSTANT LONGITUDINAL MAGNETIC FIELD [DIE NICHTLINEARE WECHSELWIRKUNG EINER STATIONAEREN ZIRKULAR POLARISIERTEN ELEKTROMAGNETISCHEN WELLE MIT EINEM KALTEN PLASMA IM KONSTATEN LONGITUDINALEN MAGNETFELD]

Werner Luenow Jan. 1968 32 p refs In GERMAN; ENGLISH summary

(IPP/6/62) CFSTI: HC $3.00/MF $0.65

The strictly relativistic, non-linear solution describing the interaction of a stationary, circularly polarized electromagnetic wave with a cold plasma in a constant longitudinal magnetic field is derived. Apart from the a priori restriction that the plasma in the wave-plasma-magnetic field system under consideration be cold, no other restriction is imposed on the range of validity of the solution. Provided the solution exists, it is thus valid for any values of the parameters. The solution allows exact study of the resonance behavior and cut-off behavior of wave-plasma-magnetic field systems of the kind described. The non-linear relations between the wave, plasma, and field parameters can be solved numerically without approximations. Owing to the complicated nature of the equations a special case is treated which at least conveys some idea of the general relationships. Author

N68-32414 Florida State Univ., Tallahassee.

HARMONIC GENERATION RESULTING FROM THE PASSAGE OF AN ELECTROMAGNETIC WAVE THROUGH AN IONIZED GAS SLAB

Richard William Vogel (Ph.D. Thesis) 1967 143 p

Available from Univ. Microfilms: HC $6.80/MF $3.00 Order No. 67-14463

The effect of collisions on harmonic generation in an ionized gas slab through which an electromagnetic wave is passing is considered. Electron neutral particle elastic collisions are assumed to dominate with a collision cross-section dependence $\sigma \alpha u^P$ where u is the relative speed between the electron and neutral molecule. An approximate distribution function is assumed which contains five undetermined parameters. Boltzmann's transport equation is used to obtain three kinetic equations; the kinetic equations are coupled to Maxwell's equations and a Fourier solution in time is used. The ionized gas slab is stratified into a series of individually homogeneous stratum and the equations are solved. The electron temperature and electric field profiles are plotted for various P dependencies of the collision cross-section. The first harmonic transmitted and third harmonic generated power are calculated and plotted versus input power for several values of P. Dissert. Abstr.

N68-32432# Institut fur Plasmaphysik G.m.b.H., Garching (West Germany).

ISAR 2, A 500 KJ DOUBLE-FED LINEAR THETA-PINCH

G. Klement, A. Knobloch, R. C. Kunze, G. Nuetzel, and H. Schlageter Jun. 1968 38 p refs Presented at the 5th Symp. on Fusion Technol., Oxford, 2–5 Jul. 1968

(IPP-4/58) CFSTI: HC $3.00/MF $0.65

Two half-banks of 250 kJ each are discharged into a double-fed coil. This design allows the high frequency of about 90 KHz and a better symmetry of the magnetic field configuration. The experiment can be run with partial energy (steps of 20% of the maximum), where for every possible energy step the feed of the current is axisymmetric with respect to the minor axis for a linear coil and point symmetric for a single fed torus. Making the collector width equal to the coil length in the linear case, any change from a linear coil to a toroidal one will be relatively easy. The geometrical design of the installation was governed by these features. The arrangements of the complete installation and the auxiliary units, which were determined by the special conditions, are described. The experiment is equipped with a premagnetization bank and a theta pinch preionization unit. The assembling of the banks and, in some cases the manufacture of some components was supervised with the aid of job planning techniques. Author

N68-32474 National Lending Library for Science and Technology, Boston Spa (England).

STUDY OF DAMAGE TO ELECTRODE SURFACES DURING BREAKDOWN IN A VACUUM [IZUCHENIE POVREZDDENII POVERKHNOSTEI ELEKTRODOV PRI PROBOE V VAKUUME]

I. L. Gufel'd [1968] 12 p refs Transl. into ENGLISH from Zh. Tekh. Fiz. (Leningrad), v. 38, no. 2, 1968 p 304–308

(M-7180) Available from Natl. Lending Library, Boston Spa, Engl.

The results of experiments to study surface damage to electrodes after single breakdowns in a vacuum are described. The appearance of defects is associated with the development of ion currents from the anode. Author

N68-32494# Institut fur Plasmaphysik G.m.b.H., Garching (West Germany).

HIGH FREQUENCY-ANALOGUE MODEL FOR MEASURING MAGNETIC FIELD DISTURBANCES IN A THETA PINCH COIL [EIN HOCHFREQUENZ-ANALOGMODELL ZUR MESSUNG VON MAGNETFELDSTOERUNGEN IN EINER THETAPINCH SPULE]

F. Hartz, J. Junker, and G. H. Wolf Mar. 1968 21 p refs In GERMAN; ENGLISH summary

(IPP-1/80) CFSTI: HC $3.00/MF $0.65

An analogue experiment for measuring the magnetic field of a theta pinch coil is described. The magnetic field is produced in a model coil with a high-frequency generator (714 kHz) and is

measured with an induction coil (approx. 1 mm in diam.) by comparison with a reference voltage. A 2 mm wide slit between the segments of a cylindrical theta pinch coil 5 cm in radius disturbs the uniform field at the inner wall of the discharge vessel (r_v = 4.25 cm) by 0.8%. With a collector slit 1 mm wide the measured disturbance at r = 4.9 cm is −1.3% at the "dents" (i.e. a cross section with $r = r_{min}$) and + 1.1% at the "bumps" (i.e. a cross section with $r = r_{max}$). This disturbance decreases with the radius to −0.2 % and + 0.4 % respectively at r = 3 cm. From r = 4.9 cm to the axis the magnitude of the undisturbed field decreases 10% at the dents and increases 10% at the bumps. In the axial direction the field decreases from the cross section at a dent to that at a bump by 25% at r = 4.9 cm and approx. 5% near the axis. Author

N68-32502# Institut fur Plasmaphysik G.m.b.H., Garching (West Germany).

MEASUREMENT OF THE ION TEMPERATURE IN THE THETA PINCH ISAR 3 BY LASER FORWARD SCATTERING [MESSUNG DER IONENTEMPERATUR AM THETA-PINCH ISAR 3 MITTELS LASER VORWAERTSSTREUUNG]

H. Roehr and G. Decker Mar. 1968 26 p refs In GERMAN; ENGLISH summary
(IPP-1/78) CFSTI: HC $3.00/MF $0.65

An experiment which allows measurement of a collective scattering spectrum of a plasma in the forward direction (7°) in a single discharge is described. The ion temperatures were determined from the scattering spectra for filling pressures between 10 and 100 μD_2. To improve accuracy the electron temperature was also measured by a 90° scattering experiment. In all cases measured spectra agreed within experimental accuracy with those expected of thermal plasmas. The electron temperatures were in all cases approximately 175 eV near the time of maximum B field. However the ion temperature changed from about 650 eV at 10 mTorr D_2 to about 175 eV at 100 mTorr D_2. This behaviour is expected from heating and loss mechanisms characteristic of theta pinches. Author

N68-32550*# Princeton Univ., N. J. Guggenheim Aerospace Propulsion Labs.

PULSED ELECTROMAGNETIC GAS ACCELERATION Semiannual Progress Report, 1 Jan.-30 Jun. 1968

Robert G. Jahn and Woldemar F. von Jaskowsky 1 Jul. 1968 89 p refs
(Grant NGL-31-001-005)
(NASA-CR-96227; Rept.-634k; SAPR-12) CFSTI: HC $3.00/MF $0.65 CSCL 20I

Studies of the spontaneous transition of a parallel plate accelerator from a transient sweeping mode to a quasi-steady blowing mode have been extended to sufficiently long pulse times that the influence of externally injected mass flow can be clearly discerned. By Kerr cell photography of the downstream flow over a wedge, and by terminal voltage signatures, it is possible to distinguish situations of adequate mass flow injection, of mass starvation, and of mass overload of a given quasi-steady discharge configuration. A shock tube gas injection system for a high power magnetoplasmadynamic arc simulator has been devised which can provide mass flows up to 50 gm/sec of argon for three milliseconds, with a rise time of one millisecond. The feasibility of gas laser interferometric determination of electron density profiles through propagating current sheets has been established in a calibration experiment, encouraging application of this technique to the parallel plate and quasi-steady MPD accelerators. Author

N68-32562*# Pittsburgh Univ., Pa. Space Research Coordination Center.

IONIZATION OF IONS

Brian K. Thomas and J. D. Garcia (Ariz. Univ., Tucson) 14 Aug. 1968 23 p refs
(Grant NGR-39-011-035)
(NASA-CR-96233; SRCC-83) CFSTI: HC $3.00/MF $0.65 CSCL 20I

The classical binary encounter model for ionization by charged particle impact is modified to permit evaluation of the cross section for ionization of positive ions by electron impact. General scalable expressions are obtained and compared with available experimental data and quantum theoretical approximations. The dependence on ionic charge is discussed, and a simple physical interpretation emerges. Results indicate that this model is as reliable as the Born approximation for this process; i.e., they agree very well with experiments for energies much larger than threshold and are everywhere within a factor of two. Author

N68-32645# Polytechnic Inst. of Brooklyn, Farmingdale, N. Y. Dept. of Electrophysics.

EXPERIMENTS ON RESISTIVE INSTABILITIES IN A TOROIDAL PLASMA

Kenneth Stuart Dec. 1967 151 p refs
(Contract Nonr-839(38); ARPA Order 829)
(PIBMRI-1379-67; AD-671901)

Visual observations made on a pulsed toroidal plasma indicate that the current carrying plasma sheet breaks up into filaments parallel to the direction of the current and perpendicular to the direction of the magnetic field. This process involves the annihilation and fusion of initially opposite magnetic flux lines and leads to a final configuration which corresponds to a lower energy state. Such a state, however, would not be accessible in the absence of dissipation since its attainment requires slippage of the plasma across magnetic flux lines. The operating mechanism must then be associated with a resistive instability of the type first predicted by Furth, Killeen, and Rosenbluth and also by Coppi, Greene and Johnson in Physics of Fluids, Volume 6, 1963. Observations of resistive instabilities under laboratory conditions is of particular interest because these modes are held responsible for many astrophysical and geophysical phenomena such as solar flares and auroras as well as anomalous diffusion rates in fusion devices. The experimental setup consists of a plasma filled ring-shaped container of rectangular cross section, where a discharge is induced by means of an iron cored transformer. The time development of the current distribution in the plasma is determined with the help of a combination of magnetic probes and an S. T. L. Image Converter Camera. Optical spectroscopy is used to calculate the temporal variation of electron number density and temperature. Author (TAB)

N68-32681# Innsbruck Univ. (Austria). Inst. for Theoretical Physics.

WORK DONE 1967/68 AT INNSBRUCK UNIVERSITY ON INSTABILITIES, THE VLASOV EQUATION, FARADAY GENERATORS, MHD BOUNDARY LAYER PROBLEMS AND HIGH CONDUCTIVITY PLASMAS

F. Cap, H. Falser, D. Floriani, H. Friedel, and F. Herrnegger 25 Apr. 1968 21 p refs
(Contract F61052-67-C-0014)
(AFOSR-68-1323; SR-57; AD-671647)

Contents: Helmholtz instability analysis; Stability criteria for finite electric conductivity; Microwave-reflection and stability in a Vlasov-plasma; Applications. TAB

N68-32708 Rice Univ., Houston, Tex.

EQUATIONS OF CHANGE FOR A PHOTON GAS AND THEIR CORRESPONDENCE WITH MAXWELL'S EQUATIONS

Robert Clifford Ried, Jr. (Ph.D. Thesis) 1967 80 p
Available from Univ. Microfilms: HC $4.20/MF $3.00 Order No. 67-13116

The transport of energy and momentum by thermal radiation is formulated on the basis of a photon gas and on the basis of transverse electromagnetic waves. These independent formulations are both classical and statistical. Interactions between the radiation and a dilute medium are considered only in a general manner. The photon gas formulation is based on an assumed validity of the Boltzmann equation in a defined phase space. The vector characteristics of photon momentum are retained and an analogy is drawn with the statistical approach to molecular gas dynamics. The energy and momentum equations obtained in this manner appear to contain a reasonable description of the overall behavior of thermal radiation. The electromagnetic wave formulation is based on the microscopic form of Maxwell's equations. A comparison is also made between the equations of change for a photon gas and the normal equations of motion for fluid mechanics. It is shown that a velocity dependent force may exist between the photon gas and the molecular gas. Dissert. Abstr.

N68-32742# New York Univ., N. Y. Physics Dept.
COLLECTIVE EFFECTS AND THE SCATTERING OF ATOMIC BEAMS FROM PLASMAS
Byron Goldstein 29 May 1968 47 p refs
(Contract Nonr-285(58))
(N68-3; AD-671838)

The possibilities of detecting collective effects in laboratory plasmas through the use of atomic beam scattering experiments are investigated. In the Impulse Approximation the differential cross section for scattering of an atom, with one effective electron, from a two-component plasma is obtained. A model calculation for the scattering of a thermal hydrogen beam from an equilibrium cesium plasma is outlined. An effective range theory is used to describe the atom-electron scattering amplitude and a semi-classical theory is used to describe the atom-ion scattering amplitude. A hydrogen beam of energy .23ev scattering from a cesium plasma with a particle density of 10 to the 14th power/cc and a temperature of .23ev is considered. For these values of the beam and plasma parameters the differential cross section is given in terms of the ion and ion-electron static factors plus integrals over the electron coherent and incoherent dynamic form factors. If the Convolution Approximation of Vineyard is used to obtain the electron incoherent dynamic form factor in terms of the electron coherent dynamic form factor, it leads directly to the prediction that the spin-flip cross section will be enhanced as the scattering angle goes to zero. Author (TAB)

N68-32748*# Aztec School of Languages, Inc., Acton, Mass. Research Translation Div.
HIGH TEMPERATURE ENERGY SYSTEMS WITH PLASMA REACTORS AND INDUCTIVE MAGNETOPLASMADYNAMIC CONVERTERS [HOCHTEMPERATUR-ENERGIESYSTEME UNTER VERWENDUNG VON PLASMAREAKTOREN UND INDUKTIVEN MAGNETOPLASMADYNAMISCHEN WANDLERN]
W. Peschka Washington NASA Sep. 1968 16 p refs Transl. into ENGLISH from Deutsche Luft-und Raumfahrt Rept. DVL-697, Sep. 1967 25 p
(Contract NASw-1692)
(NASA-TT-F-11882) CFSTI: HC $3.00/MF $0.65 CSCL 20I

The purpose of this paper is to investigate possible future power generating equipment which operates with high temperature plasma as a working medium and subsequently with high power density. This temperature range requires reactors whose nuclear fuel is in the plasma (fission or fusion reactors) coupled to magnetoplasma-dynamic generators acting as energy converters. Electrodeless MPD-Generators with all their advantages can be successfully employed. The technological ramifications arising from the application of these high temperatures with respect to the reactors and the MPD-Generators as well as to the heat release equipment are discussed. Author

N68-32759# New York Univ., N. Y. Physics Dept.
TRANSPORT THEORY OF PARTIALLY DEGENERATE PLASMA
Martin Lampe May 1968 18 p refs
(Contract Nonr-285(58))
(N68-1; AD-671837)

The transport coefficients of a high temperature, weakly coupled plasma of non-degenerate ions and partially degenerate electrons (i.e. stellar matter) are calculated by means of a Chapman-Enskog solution of the quantum Lenard-Balescu kinetic equation. Both electron-electron and electron-ion collisions are included. The leading term of the transport coefficients, the Coulomb logarithm, is evaluated exactly and relatively simply for all degrees of electron degeneracy. The method is applicable to any partially degenerate system with weak, long-range particle interactions. Author (TAB)

N68-32762 Polytechnic Inst. of Brooklyn, N. Y.
CERENKOV RADIATION IN DIELECTRIC AND PLASMA FILLED INFINITE SPACE AND CAVITIES
Richard Joseph Sasiela (Ph.D. Thesis) 1967 154 p
Available from Univ. Microfilms: HC $7.20/MF $3.00 Order No. 67-13417

The radiation of uniformly moving charged particles in dielectric and plasma filled structures is studied. The structures studied are infinite space, waveguides and cavities. The purpose of the study is as follows: 1.) to determine how the energy radiated in plasma filled cavities compares with that radiated in dielectric filled cavities. 2.) to see if there is any way of analtyically separating the energy due to Cerenkov radiation from the other sources of energy when metal structures are present. Dissert. Abstr.

N68-32812# ARO, Inc., Arnold Air Force Station, Tenn.
STUDIES OF ELECTRICAL CHARACTERISTICS OF GASDYNAMIC BOUNDARY LAYERS IN SEEDED DIATOMIC GASES Final Report, Jul. 1966–Jan 1968
E. E. Goins and Wendell Norman Arnold Eng. Develop. Center Jun. 1968 71 p refs
(Contract AF 40(600)-1200
(AEDC-TR-68-111; AD-671528)

Calculations are presented of the excess boundary-layer voltage drop attributable to the conduction of current through a thermal boundary layer on the electrodes of an MHD accelerator operating with seeded air or nitrogen, using the two-temperature model of Kerrebrock. For a laminar boundary layer, the excess boundary-layer voltage drop is found to be a linear function of pressure, relatively insensitive to free-stream temperature and seed fraction, and larger for air than for nitrogen. Experiments conducted in a shock tube showed an asymmetry in the voltage distribution for seeded air, with the cathode drop approximately 30 v and the anode drop approximately 10 v. Author (TAB)

N68-32933# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
PHYSICAL PHENOMENA ACCOMPANYING INDUCTIVE ACTION OF A TRAVELING MAGNETIC FIELD ON A LAYER OF LIQUID METAL [FIZICHESKIYE YAVLENIYA PRI INDUKTSIONNOM VOZDEYSTVII BEGUSHCHEGO MAGNITNOGO POLYA NA SLOY ZHIDKOGO METALLA]
L. Ya. Ulmanis 2 Aug. 1967 14 p refs Transl. into ENGLISH from Akad. Nauk Latvian SSR, Otd. Fiz. i Tekhn. Nauk (Riga), 1963 p 3–11
(FTD-HT-67-479; AD-671749)

The results of the investigations described in the dissertation have practical significance. The conclusion that in the region M squared/Re = or < 5.3 x 10 to the -4th power the traveling magnetic field has practically no influence on turbulent flow of a conductive liquid through the channel provides a basis for calculating the flow of liquid metals in the passages of induction pumps

using the formulas of ordinary hydrodynamics. The results of the investigation of k sub os have been applied in various types of induction devices that use a traveling magnetic field. The investigations of the skin effect of the traveling magnetic field open approaches to the design of measuring instruments. TAB

N68-33003# California Univ., Berkeley. Div. of Aeronautical Sciences.
VELOCITY DETERMINATION BY THE MEASUREMENT OF THE INDUCED POTENTIAL IN A NONUNIFORM PLASMA FLOW
W. F. Dove, W. B. Kunkel, and L. Talbot May 1968 162 p refs
(Grants NSF GK-1297; AFOSR-538-68)
(AS-68-3; AD-671493)

An experimental and theoretical investigation into the validity of the equation for the determination of the velocity of an ionized gas by the measurement of induced potential differences is presented. The experimental program provides the results of a series of measurements of the change in induced potential in a low density arc heated argon plasma jet for a given increment in the externally applied magnetic induction field. A theoretical prediction for the induced potential is developed from Maxwells equations for a continuous media with an assumed non-uniform velocity field. The influence of the finite extent of the magnetic field is explicitly formulated, and the influence of various constitutive relations between current and potential gradients is investigated. The majority of the results were obtained using a simple Ohms Law for non-relativistic velocities; however, two exact solutions for induced potential were obtained for an anisotropic electrical conductivity. The influence of other mechanisms such as induced temperature gradients on charge transport through coupling by Joule heating are explored. The data obtained in the experimental program are interpreted in terms of the results of the theoretical analysis. A procedure for determining the velocity is formulated in terms of several universal functions of the experimental observables. Author (TAB)

N68-33021*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
COLLISIONLESS SHEATHS BETWEEN FIELD-MODIFIED EMITTERS AND THERMALLY IONIZED PLASMAS EXEMPLIFIED BY CESIUM
James F. Morris Washington Aug. 1968 62 p refs
(NASA-TN-D-4376) CFSTI: HC $3.00/MF $0.65 CSCL 20I

The model, an iterative calculation method, and results for plane collisionless sheaths are presented. These sheaths separate thermally ionized plasmas from emitters of electrons, ion, and atoms and change emission with their fields. Still the model gives identical absolute potential changes through the sheath for ions and electrons, contrary to usual practice. For cesium, the emitter and plasma ion and atom temperatures range from 1600° to 2400°K with plasma electron temperatures up to 300°K higher. Plasma electron number densities are 10^{12} to 10^{15} per cubic centimeter. At these conditions work functions from 1.5 to 5 volts produce absolute potential drops from 0 to 1.5 volts for electron and positive-ion sheaths. And some currents greater than 10^2 amperes per square centimeter result. Certain generalizations apply: Sheath fields affect emissions and sheath characteristics significantly. The overall sheath characteristics correlate better with an emission Debye length (6.9 time the square root of the emitter temperature (°K) divided by the plasma electron number density (cm^{-3})) than with the conventional Debye length. Where conditions comply with the assumptions of the model, effective sheath widths decrease from 2.6 to 2 emission Debye lengths as overall sheath drops grow from less than 0.1 to 1.5 volts. Author

N68-33090# United Kindgom Atomic Energy Authority, Culham (England).
PLASMA PRODUCTION IN A GAS JET BY MICROWAVE IONIZATION
J. Hugill Dec. 1967 12 p
(CLM-R-80) CFSTI: HC $3.00/MF $0.65

An experiment is described in which cold, neutral gas issuing from a nozzle is ionized by a 2400-MHz alternating electric field. In the steady state the electron temperature in argon is 3.4 eV, and ions are accelerated by electron pressure gradients near the nozzle. When the gas flow is pulsed, the degree of ionization can be up to 2.9% and this does not represent the limit of the technique. Application to the filling of a closed magnetic trap is discussed. Author (NSA)

N68-33098# Maryland Univ., College Park.
PERIODIC PULLING AND THE TRANSISTION TO TURBULENCE IN A SYSTEM WITH DISCRETE MODES
Herbert Lashinsky Apr. 1968 43 p refs Presented at the Symp. on Turbulence of Fluids and Plasmas, New York, 16-18 Apr. 1968
(Contract AT(40-1)-3405; Grant AF-AFOSR-1016-68)
(BN-542; ORO-3405-21; CONF-680431-1) CFSTI: HC $3.00/MF $0.65

Experiments with thermal plasma devices (Q machines) frequently reveal the existence of spontaneous steady state plasma oscillations with wavelengths comparable with the system dimensions and with discrete, harmonically related, frequencies that correspond to the different azimuthal mode numbers of the universal drift instability in the cylindrical plasma column. The discrete mode spectrum is observed at low oscillation amplitudes; at higher amplitudes the discrete mode spectrum gives rise to a continuous noise spectrum, characteristic of turbulence, that implies the introduction of new degrees of freedom. A mechanism is described and analyzed by which this transition to turbulence can occur in a system characterized by a modest number of discrete modes. This mechanism, called periodic pulling, provides a means for modulation of the amplitude and frequency of the discrete modes, thus generating sidebands that eventually broaden the discrete mode frequencies until a continuous spectrum is produced. Author (NSA)

N68-33108 Polytechnic Inst. of Brooklyn, N. Y.
NONEQUILIBRIUM STRUCTURE OF HYDROMAGNETIC GAS-IONIZING SHOCK FRONTS IN ARGON
Martin Irving Hoffert (Ph.D. Thesis) 1967 65 p
Available from Univ. Microfilms: HC $3.60/MF $3.00 Order No. 67-13394

This study deals analytically with the structure of gas-ionizing hydromagnetic shock waves. Since these waves, by definition, must have non-electrically-conducting upstream states, their existence at very high shock temperatures must be ruled out on the physical grounds that forward-radiated precursor ionization makes the unshocked gas conducting. A low temperature collisionally-ionizing shock with oblique magnetic field is studied here to determine whether certain concepts which exist in the current literature are relevant. Nondimensionalized equations governing the non-equilibrium structure of such a front propagating into un-ionized argon are formulated using ionization rates and an electron energy equation developed in an earlier paper. Dissert. Abstr.

N68-33113# Stanford Univ., Calif. Radioscience Lab.
RECENT RESEARCH ON THE MAGNETOSPHERIC PLASMAPAUSE
D. L. Carpenter Jun. 1967 29 p ref

A concept that the plasmapause is a three-dimensional field aligned boundary that divides the closed field-line portion of the earth's magnetosphere into two physically distinct regions is presented. The boundary is asymmetric, usually exhibiting a

minimum geocentric range near dawn and a maximum near dusk under conditions of moderate but steady geomagnetic agitation. The mean equatorial radius of the plasmapause is typically about $4R_E$, but it may vary from about $5.5R_E$ during periods of extreme quiet to the range $2–3R_E$ during great storms. The approximately corotating thermal plasma within the boundary exhibits two types of radial drift motions. These may be visualized as: 1) slow "breathing" motions that follow the radial variations in a fixed, asymmetric boundary, 2) more rapid, transient (1–2 hour) motions that occur when the boundary position varies, as in the case during a polar substorm. Author

N68-33144# Stevens Inst. of Tech., Hoboken, N. J. Dept. of Physics.
CROSS-FIELD PLASMA TRANSPORT IN A MAGNETICALLY CONFINED LOW-BETA COLLISION DOMINATED PLASMA
George E. Courville and Kenneth C. Rogers May 1968 141 p refs
(Contract AT(30-1)-2813)
(SIT-2813-46) CFSTI: HC $3.00/MF $0.65

Measurements of plasma loss transverse to a uniform magnetic field were made with a potassium Q machine for the parameter range $2050 < T < 2350°K$, $10^{10} < n < 10^{11}$ cm^{-3} and $1000 < B < 4000$ gauss. Plasma losses were attributed to two mechanisms: M I, an E × B radial drift due to azimuthal temperature gradients at the hot ionizer plate, and M II, a wave-driven loss that has been identified as being due to a collisional drift-wave instability. Losses associated with M I can be expressed in terms of parameters by the empirical relation $\Gamma_1 = 3.8 \times 10^8 \nabla n/B^2$ cm^{-2} sec^{-1}, where ∇n is the density gradient (in cm^{-4}) and B is the magnetic field (in gauss). This loss, being related to the temperature gradient, is unavoidable (and would have a different numerical factor if the plate-plate heater geometry were altered) and represents a lower limit on the loss rate measurements. Author (NSA)

N68-33145# California Univ., Livermore. Lawrence Radiation Lab.
STATISTICAL MECHANICS OF DENSE IONIZED GASES
Hugh E. de Witt 14 May 1968 19 p refs Presented at the Intern. Conf. on Low Luminosity Stars, Charlottesville, Va., 28–30 Mar. 1968 Submitted for publication
(Contract W-7405-ENG-48)
(UCRL-71080; CONF-680317-1) CFSTI: HC $3.00/MF $0.65

Coulomb interactions in dense partially ionized gases are discussed. Results of quantum mechanical perturbation expansions in statistical mechanics of ionized gases are described. NSA

N68-33151 Johns Hopkins Univ., Baltimore, Md.
PLASMA TURBULENCE EXPERIMENTS
John Miles Kellam, Jr. (Ph.D. Thesis) 1967 266 p
Available from Univ. Microfilms: HC $12.15/MF $3.45 Order No. 67-13811

A series of arc driven shock tubes were constructed and tested for suitability as a source of plasma for an exploratory investigation of some properties of plasma turbulence. The last of these, designated as segmented tube II, was used for a series of measurements of the effect of a helium plasma on the fluctuation spectrum of an externally imposed magnetic field. Fields of 0, 355, 755, and 1970 gauss were used. A few tests also were made at 3,040 gauss. The calculated magnetic Reynolds numbers were in the approximate range from 1 to 2, based on results obtained with a conductivity probe. A statistical method using ensemble averaging was used to obtain the fluctuation spectra, which were found to follow a power law over a frequency range from approximately .2 to 1 MHz. Results from these experiments tend to support the proposition that the luminous front and plasma following it were primarily gas ejected from the discharge section, rather than shock heated gas. Dissert. Abstr.

N68-33152 North Carolina State Coll., Raleigh.
FULLY DEVELOPED MAGNETOGASDYNAMIC FLOW BETWEEN DIVERGING PLANE WALLS
James Reginald Maus, Jr. (Ph.D. Thesis) 1967 153 p
Available from Univ. Microfilms: HC $7.20/MF $3.00 Order No. 67-14920

A solution has been obtained to the magnetogasdynamic equations of motion including the effects of compressibility viscosity, thermal conductivity and crossed electric and magnetic fields. The solution obtained is valid for an acceleration flow in which a separation of variable form of solution is utilized. The constraints under which a separable solution is valid are clearly delineated. The solution is an exact solution in the sense that no terms have been dropped from the governing equations and boundary layer approximations have not been employed. The results of the investigation were presented in the form of velocity and temperature profiles for several values of the electromagnetic parameters Ha and Φ. Although the mathematical model used in the present investigation is too crude to be utilized for detailed design of a practical MHD accelerator, it is believed, nevertheless, that the model displays certain qualitative features of the flow which are likely to be encountered in a practical device. Dissert. Abstr.

N68-33158# Texas Univ., Austin. Electronics Research Center.
THE TRANSVERSE INJECTION OF A DENSE PLASMA INTO A LINEAR OCTUPOLE MAGNETIC FIELD
Jim A. Boyd and W. C. Duesterhoeft, Jr. 18 Apr. 1968 148 p refs
(Grant AF-AFOSR-766-67)
(TR-46; AFOSR-68-0877; AD-671512)

The paper presents the experimental results on the transverse injection of a dense plasma into a linear octupole magnetic field. Magnetic and electric probes were used to observe the interaction of the streaming plasma with the octupole field. By time- and space-resolving the signals from these probes, information related to the motion and density of the plasma in the octupole, current densities in the plasma and the transfer of the momentum of the plasma to the mechanical structure were determined. Author (TAB)

N68-33240*# Volt Technical Corp., Washington, D. C.
CERTAIN PECULARITIES IN THE DISTRIBUTION OF PLASMA CONCENTRATION AND OF THE FIELD OF ALFVEN WAVES IN THE EARTH'S MAGNETOSPHERE
Yu. A. Kopytenko and O. M. Raspopov 29 Aug. 1968 7 p refs Transl. into ENGLISH from Kosmich. Issled. (Moscow), v. 6, no. 4, 1968 p 612–616
(Contract NAS5-12487)
(NASA-CR-96313; ST-PF-GM-10747) CFSTI: $3.00 CSCL 20I

The peculiarities are considered of plasma concentration and the velocity field of Alfven wave distribution in the earth's magnetosphere, taking into account the distortion of the earth's magnetic dipole field by the radiation belt's ring current field. The presence of the latter in the earth's magnetosphere results in the variation of propagation conditions of magneto-hydrodynamic waves. Obtained in particular is an outstripping effect of the Alfven wave propagating along the field line closest to the Earth. An identical effect of outstripping is possible during propagation of whistlers. Author

N68-33252*# Volt Technical Corp., Washington, D. C.
NONLINEAR WAVES WITH A MAGNETIC FIELD IN THE COSMIC PLASMA
M. A. Gintsburg Greenbelt, Md. NASA. Goddard Space Flight Center 22 Aug. 1968 9 p refs Transl. into ENGLISH from Astron. Zh. (Moscow), v. 45, no. 3, 1968 p 610–615
(Contract NAS5-12487)
(NASA-CR-96276; ST-PP-CR-SP-10736) CFSTI: HC $3.00/MF $0.65 CSCL 20I

A new solution of two-fluid hydromagnetic equations is obtained in the form of large amplitude nonlinear ion waves. The magnetic field vector of such a wave rotates and changes its magnitude simultaneously. There exists experimental evidence of these nonlinear oblique waves propagating in cosmic space. A new mechanism of plasma penetration into the magnetosheath and into the magnetosphere is also suggested—average plasma flow due to the nonlinear character of these waves. Nonlinear ion waves of relativistic velocities are also considered giving a new mechanism for cosmic rays generation. As an example the acceleration of cosmic rays in a solar flare is computed. Author

N68-33365# Aerospace Corp., El Segundo, Calif. Lab. Operations.
A STEADY STATE PLASMA FACILITY
Stanley L. Leonard Mar. 1968 55 p refs
(Contract F04695-67-C-0158)
(TR-0158(3220-20)-1; SAMSO-TR-68-234; AD-671979)

A facility is described in which a magnetically confined column of highly ionized argon or helium plasma is produced. The primary plasma is generated in a hollow-cathode arc and diffuses along a magnetic field through a region where neutral particles are preferentially removed. Detailed Langmuir probe measurements were carried out in the argon plasma. Spectroscopic observations have included measurements of absolute continuum intensity, relative intensities of lines emitted by a given species (e.g., HeI, ArII), and ratios of the intensities of lines emitted in successive ionization stages of the same atom. From the probe and spectral measurements the peak electron temperature in argon is found to be 3.0 eV, while the peak electron number density is 5(10 to the 13th power)/cc. The corresponding numbers for helium are 4 eV and (10 to the 14th power)/cc. Relative intensity measurements of HeI and HeII lines appear to be strongly influenced by the influx into the plasma column of background neutral particles whose mean free path is long compared to the diameter of the plasma column. Author (TAB)

N68-33372*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
THE PREHEATING OF PLASMA IN A MEGAJOULE THETA-PINCH EXPERIMENT
W. A. Cilliers, Joseph Norwood, Jr., and G. K. Oertel Washington Sep. 1968 22 p refs
(NASA-TN-D-4708) CFSTI: HC $3.00/MF $0.65 CSCL 20I

The preheating of plasma in a megajoule theta-pinch experiment was investigated and distinct modes of operation have been delineated. The criteria for satisfactory preionization are discussed. For typical experiments where a number of discharges from different capacitor banks are applied sequentially to a common load, these criteria are determined not only by the requirement for a reproducible and stable plasma, but also by the limitations on the voltage that can be applied to the coil without precipitating prefire of banks that should fire later in the sequence. A range of preheater energies and a bank voltage that are satisfactory for this particular experiment were determined. Streak photographic evidence of plasma conditions in the various modes is presented. Author

N68-33438# Los Alamos Scientific Lab., N. Mex.
ON THE MECHANISM OF NEUTRON PRODUCTION FROM THE DENSE PLASMA FOCUS
P. J. Bottoms, J. P. Carpenter, J. W. Mather, K. D. Ware, and A. H. Williams [1967] 15 p refs Presented at 3d Intern. Conf. on Controlled and Plasma Phys., Novosibirsk, USSR
(Contract W-7405-ENG-36)
(LA-DC-9327; CONF-680805-2) CFSTI: HC $3.00/MF $0.65

The dense plasma focus (DPF), a self-constricted plasma current discharge (z-pinch), is an intense source of neutrons (10^{10}/burst). The lifetime of the plasma, measured in terms of neutron production, is ≈80 to 150 nsec. The DPF device consists of a 20-kV, 360-μf capacitor bank, coaxial electrodes of 15-cm-outer and 10-cm-inner diameter operating with deuterium gas pressures of 5 to 10 torr. An electron plasma temperature and density of 5 to 8 keV and ≈ 2×10^{19}/cm^3, respectively, are typical values. The initial heating of the plasma ions is accomplished during the rapid 2-dimensional r, z compression; the fountain shape of the converging current sheath produces plasma streaming and precludes any real confinement. A study of the pulsed neutron energy spectrum by the time-of-flight technique made at angles of 0, π/2, and π radians shows that the average neutron energy is 2.77, 2.59, and 2.22 MeV, respectively. The center-of-mass velocity of the plasma source is 1.24×10^8 cm/sec. Author (NSA)

N68-33449# Institut fur Plasmaphysik G.m.b.H., Garching (West Germany).
TWO DIMENSIONAL THETA PINCH DYNAMICS WITH TRANSVERSE MAGNETIC FIELDS [ZWEIDIMENSIONALE THETAPINCH-DYNAMIK BIE TRANSVERSALEN MAGNETFELDERN]
D. Duechs Apr. 1968 73 p refs In GERMAN; ENGLISH summary
(IPP-1/81) CFSTI: HC $3.00/MF $0.65

The complete set of equations for the two-fluid model of a fully ionized plasma, the parameters of which depend on two spatial dimensions and time, is solved by a computer program. This program is applied to the problem of plasma rotation in a theta pinch caused by transverse multipole fields. The results show that the plasma does not rotate like a cylindirical rigid body, rather the velocity varies strongly with azimuth. Morever the rotation is changing direction along the radius. Therefore transfer of angular momentum from outside is not necessary for the existence of rotation. Even in small transverse fields (B≈500 gauss) the rise time for the angular velocity is of the order of 10^{-7} sec and very short compared with those obtained from previous theoretical models. Author

N68-33461 Rice Univ., Houston, Tex.
SPECTROSCOPIC STUDY OF ELECTRON-ION RECOMBINATION IN AN ARGON PLASMA
Milton Arthur Frost, III (Ph.D. Thesis) 1967 70 p
Available from Univ. Microfilms: HC $3.80/MF $3.00 Order No. 67-13072

Detailed spectroscopic studies were made of the recombination process in an argon plasma jet in a low-density wind tunnel. Determination of the decay rate was based on measurement of the absolute intensities of the various transitions of the argon atom and calculated excitation cross sections based on an approximation to the classical method of Gryzinski. The effect of the metastable states was considered and was found to account for the principal reactions as well as the afterglow in the jet. Data taken at a position one inch downstream of a sonic orifice gave a recombination rate of approximately 10^{-12} cm^3/sec; at this location the electron temperature was 4390°K and the electron density was 9.3×10^{12} cm^{-3}. It was found that the plasma could be analytically represented very well by considering it to be a metastable atom gas whose ground level energy is equal to the energy of the metastable level of the ordinary argon atom. Dissert. Abstr.

N68-33494# United Kingdom Atomic Energy Authority, Culham (England). Research Group.
METHOD FOR THE MICROWAVE HEATING OF PLASMA ELECTRONS
E. S. Hotston, J. M. Weaver, and D. J. H. Wort Jan. 1968 20 p refs
(CLM-R-78) CFSTI: HC $3.00/MF $0.65

Examination of the Appleton–Hartree equation reveals the existence of a wave which propagates in the plasma and is subject both to strong collisional absorption and Landau damping, and

which could thus be used to heat plasma electrons. The wave may be launched by coupling from a microwave slow-wave structure outside the plasma, although the launching efficiency is poor if a conventional TM structure is used. If a TE structure can be developed, the coupling to the plasma would be greatly improved. A free-space treatment of the coupling is supported by an alternative treatment which regards plasma and slow-wave structure as an integrated whole; this allows a rigorous analysis of the effect of the plasma boundaries and permits the inclusion of non-uniform plasma, but cannot give the efficiency of the coupling between structure and plasma. It is concluded that provided an efficient TE slow wave structure can be developed, a plasma electron heating method of wide application has been found. Author (NSA)

N68-33504*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
BOUNDARY CONDITIONS AND ITERATIVE PROCEDURES FOR PLASMA SHEATH PROBLEMS
Lee W. Parker (Mt. Auburn Res. Associates, Inc.) and Edward C. Sullivan [1968] 8 p refs Presented at 6th Intern. Symp. on Rarified Gas Dyn., Cambridge, Mass., 22–26 Jul. 1968
(NASA-TM-X-61166) CFSTI: HC $3.00/MF $0.65 CSCL 20I

Computer methods have recently been applied to a large class of steady state collisionless plasma sheath problems, including, for example, moving satellites in the ionosphere, stationary plasma probes, ion engines, and plasma diodes. These problems involve numerical solutions of the Poisson equation. One aspect of such solutions which can cause difficulties is that in many cases one boundary is at infinity, where the potential and net charge density vanish. Because of the limitations of digital computers, the potential and density descriptions are restricted to a finite portion of space, so that the boundary condition corresponding to infinity must be simulated by a necessarily artificial finite condition. Another aspect is that the density is generally a nonlinear functional of the potential distribution, and that, with specified boundary conditions, an iteration procedure must be used in order to obtain a self-consistent solution. The stability of the iteration procedure depends, not only on the particular algorithm, but also on the artificial boundary condition employed, as will be shown later. Author

N68-33579# Polish Academy of Sciences, Warsaw.
MONOCHROMATOR MEASUREMENTS OF ION VELOCITIES IN A ROD PLASMA INJECTOR [POMIAR PREDKOSCI JONOW W PRETOWYM INJEKTORZE PLAZMOWYM PRZY POMOCY MONOCHROMATORA]
S. Suckewer, S. Kulinski, and J. Nowikowski 1968 20 p refs Presented at the 3rd Intern. Conf. on Controlled and Plasma Phys., Novosibirsk, USSR, 1–7 Aug. 1968
(INR-P-833/XVIII/PP; CONF-680805-1)

The axial speeds of different groups of ions were measured in a rod plasma injector with the aid of monochromator. The main result was that velocities of different groups of ions were practically equal. The average velocity of ions was about 5.5×10^6 cm/sec for delay time of gas supply $\tau = 60$ μs, and 3.5×10^6 cm/sec for $\tau = 240$ μs. It appeared also that all the groups of ions are mixed in a plasmoid and no ordered pattern exists concerning the distribution of ions in the plasmoid. The speed of the plasmoid was also estimated with the aid of ultrafast photography. A reasonably good agreement was observed between the velocities of ions and those of plasmoids. Results are discussed, along with attempts to find a suitable theoretical explanation of the results. Author (NSA)

N68-33592*# Michigan Univ., Ann Arbor. Dept. of Aerospace Engineering.
FLUID MECHANICS OF MAGNETICALLY BALANCED ARCS IN CROSS FLOWS Final Report
S. W. Bowen Jul. 1968 10 p refs
(Grant NGR-23-005-128; ORA Proj. 07912)
(NASA-CR-96474; Rept.-07912-5-F) CFSTI: HC $3.00/MF $0.65 CSCL 20I

The properties of magnetically balanced arcs in a supersonic flow of air were investigated. The arc behaves somewhat like a solid body, impervious with respect to the external flow. This behavior was experimentally verified by the fact that small magnesium tracer particles introduced into the arc near the upstream anode root were carried along within the arc column for a substantial fraction of the arc length at velocities on the order of 10 m/sec. The free stream velocity was about 600 m/sec. The significant similarity parameters for the arc are briefly discussed, including Lorentz convection, power loading, Prandtl number, and Eckert number. As a combination of these parameters, the joule heating parameter is formed. Numerical computer studies as well as experimental measurements of luminosity profiles were also made to study interior temperature distribution and flow patterns in the arc. K.W.

26 PHYSICS, SOLID-STATE

Includes semiconductor theory; and superconductivity. For applications see: 16 Masers. For related information see also: 10 Electronics.

N68-32236 Rutgers Univ., New Brunswick, N. J.
HIGH FIELD LOSSES OF ADULTERATED LEAD ZIRCONATE-TITANATE PIEZOELECTRIC CERAMICS
Robert Anthony Gdula (Ph.D. Thesis) 1967 124 p
Available from Univ. Microfilms: HC $8.00/MF $3.00 Order No. 67-14710

The high field losses of adulterated lead zirconate-titanate ceramics were compared on the basis of rates of temperature rise of standard size samples in the same transducer configuration. Systematic chemical modification in light of the ionic model of the perovskite structure was used to produce ceramics with widely varying high field behavior. It was found that high field losses could be greatly reduced by adulteration of either cation site with ions of lower than normal valency. At 1 atom% concentration of adulterant lowest losses were found with adulterants whose valence was one unit less than normal. The results are explained as stoichiometric effects. Normal air fired lead zirconate-titanate ceramics are considered to be overoxidized. Adulteration with subvalent cations reduces the total oxygen content of the ceramic and brings it toward true ABO_3 stoichiometry. Lowest losses are postulated for truly stoichiometric bodies. Dissert. Abstr.

N68-32260 Case Inst. of Tech., Cleveland, Ohio.
THE THEORY OF THE MEISSNER EFFECT
Charles William Ruth (Ph.D. Thesis) 1967 101 p
Available from Univ. Microfilms: HC $5.20/MF $3.00 Order No. 67-16099

The purpose of this work is to calculate the magnetic field penetration predicted by the simple energy gap theory and the Bardeen, Cooper, and Schrieffer (B.C.S.) theory of superconductivity. These theories are based on the model that uses a quantum gas of electrons to represent a superconductor. The electrons experience interactions with the lattice and each other, and the average of these interactions is assumed to produce a gap in the spectrum of electron energy levels. Although these theories have been used to examine the magnetic response of superconductors, the analyses have been based on various mathematical approximations whose validity might be questioned. In addition, these approximate analyses have been used to predict the London value for the penetration

depth at T = 0°K, which is not in agreement with experiment. One expects a satisfactory model for superconductivity to predict the Meissner effect, the exclusion of the magnetic field from the interior of the superconductor. Dissert. Abstr.

N68-32262 Cornell Univ., Ithaca, N. Y.
EFFECTS OF IMPURITIES ON LATTICE VIBRATIONS: A MODEL CALCULATION INCLUDING MASS AND FORCE CONSTANT CHANGES; NEUTRON SCATTERING
Katja Sifnaghel Lakatos (Ph.D. Thesis) 1967 275 p
Available from Univ. Microfilms: HC $12.40/MF $3.55 Order No. 67-16364

This thesis is a study of the effects of a low concentration of impurities on the vibrational properties of cubic monatomic harmonic lattices. The problem is formulated in terms of a slow neutron scattering experiment. The model used allows for both the mass of the impurity and the force constants binding it to its nearest, and in some cases next nearest, neighbors in the lattice to be different from those of a host atom. Numerical computations are performed on Al containing heavy impurities, with force constants treated as parameters which are varied over a wide range. It is found that the resonance characteristics of the impurity are much more sensitive to force constant changes than to mass change. When mass and forces change in the same direction (e.g., heavy impurity, weak force constants), there is only one impurity resonance mode. When the changes are in opposite directions, two resonances, or one resonance and one localized mode, appear. It is also found that when force constant changes occur, the neighbors of the impurity share much more in its resonance motion than when only a mass change occurs. Dissert. Abstr.

N68-32275 Cornell Univ., Ithaca, N. Y.
ELECTRON TUNNELING IN SUPERCONDUCTING CADMIUM ALUMINUM OXIDE ALUMINUM JUNCTIONS
Prabha Ramchandra Kumbhare (Ph.D. Thesis) 1967 93 p
Available from Univ. Microfilms: HC $4.80/MF $3.00 Order No. 67-13917

Films of cadmium metal were studied in the superconducting state using the technique of electron tunneling in Cd–Al_2O_3–Al junctions. The variation of the energy gap of cadmium with temperature and magnetic field was determined from the current-voltage characteristics. The measured transition temperature of the cadmium films was 0.47°K, and the energy gap at 0°K, $2\Delta(0)$, was 0.13 ± 0.005 millivolts. The extrapolated value of the critical magnetic field at 0°K for these films ranged from 30 gauss to 65 gauss. The derivative, dV/dI, of the current-voltage characteristics was studied also as a function of temperature and magnetic field. Dissert. Abstr.

N68-32290 National Lending Library for Science and Technology, Boston Spa (England).
APPLICATION OF ELECTRON MICROSCOPY TO INVESTIGATION OF RADIATION DEFECTS IN ALKALI HALIDE CRYSTALS [OPRIMENENII METODA ELEKTRONNOI MIKROSKOPII DLYA ISSLEDOVANIYA RADIATSIONNYKH DEFEKTOV V SHCHELOCHNOGALOIDNYKH KRISTALLAKH]
Yu. Ekmanis Dec. 1967 8 p refs Transl. into ENGLISH from Latvijas PSR Zinatnu Akad. Vestis (Riga), v. 4, no. 213, 1965 p 55–61
(RTS-4324) Available from Natl. Lending Library, Boston Spa, Engl.: 17s 6d

Alkali halide crystals were studied in an effort to determine optimum methods for investigating radiation effects using electron microscopy. The best results were obtained by the method of carbon gratings. The defective structures on the surface of NaCl, KCl, and LiF crystals irradiated with gamma rays between 10^6 rad and 10^9 rad were successfully revealed. K.W.

N68-32291 National Lending Library for Science and Technology, Boston Spa (England).
THE PROBLEM OF OHMIC TRANSPARENT CONTACT TO PHOTOCONDUCTORS OF THE A^2B^6 TYPE [DO PITANNYA PRO OMICHNII PROZORII KONTAKT DO FOTOPROVODNIKIV TIPU A^2B^6]
S. V. Svechnykov, Yu. A. Tkhoryk, and Yu. G. Pis'mennyy Feb. 1968 7 p Transl. into ENGLISH from Ukr. Fiz. Zh. (Kiev), v. 11, no. 1, 1966 p 40–44
(RTS-4335) Available from Natl. Lending Library, Boston Spa, Engl.: 12s 6d

Discussed is the possibility of using CdO films as transparent ohmic contacts for CdS-type single crystal and film photoconductors. An analysis of volt-ampere and noise characteristics of such contacts shows that they are stable. The linearity of the contacts is due to the creation of a thin film enriched with cadmium on the CdS surface. Cadmium enrichment also enhances the conductivity of CdO films obtained by reactive cathodic atomization. It is possible that a thin transparent film of cadmium is created at the CdS–CdO boundary which assists the emergence of a nonoccluded contact. K.W.

N68-32303 National Lending Library for Science and Technology, Boston Spa (England).
EFFECT OF PLASTIC STRAIN ON THE TEMPERATURE DEPENDENCE OF THE MAGNETIC PROPERTIES OF SILICON IRON [VLIYANIE PLASTICHESKOI DEFORMATSII NA TEMPERATURNUYU ZAVISIMOST' MAGNITNYKH SVOISTV KREMNISTOGO ZHELEZA]
D. D. Mishin and V. G. Pleshchev May 1968 8 p refs Transl. into ENGLISH from Izv. Vysshikh Uchebn. Zavedenii, Fiz. (Tomsk), v. 9, 1967 p 147–149
(RTS-4542) Available from Natl. Lending Library, Boston Spa, Engl.: 7s 6d

A study was carried out on the effect of plastic strain on the temperature dependence of the magnetic properties of silicon iron to establish details of the unique relationship between the dislocation of structure and the coercive force. In silicon iron the temperature dependence of the constants of magnetocrystalline anisotropy and magnetostriction differ both quantitatively and qualitatively; therefore the magnetoelastic anisotropy due to the dislocated structure, and its influence on the properties of silicon iron can be clearly indicated by studying the temperature dependence of the magnetic properties of this material. The magnetoelastic anisotropy is expressed by terms of the $\lambda\sigma$ type, where λ is the magnetostrictive constant and σ denotes the internal elastic stresses in the material. In single crystals of silicon iron these elastic stresses are in the main caused by dislocations. Author

N68-32306 Catholic Univ. of America, Washington, D. C.
CRITICAL MAGNETIC FIELDS OF THE SUPERCONDUCTING, SEMICONDUCTING, NONSTOICHIOMETRIC COMPOUNDS SN(1-X) TE(1) AT ULTRA-LOW TEMPERATURES
Robert Aloysius Hein (Ph.D. Thesis) 1967 173 p
Available from Univ. Microfilms: HC $8.00/MF $3.00 Order No. 67-15470

The results of an experimental investigation of the occurrence and nature of superconductivity in the degenerate semiconducting SnTe compounds are presented. Magnetic susceptibility measurements were employed to measure the upper critical magnetic field, H_{c2}, as a function of temperature and composition of the sample. The composition range investigated corresponded to values of x, defined by the formula $Sn_{1-x}Te_1$, of $0.010 < x < 0.034$. Temperatures as low as 0.12°K were produced by means of the magnetic cooling technique. Magnetization curves were also obtained for various fixed values of the temperature. These studies clearly establish the nature of the superconducting state as Type II superconductivity. Analysis of the data in light of the GLAG theory of superconductivity indicates that the Ginsburg–Landau

parameter, κ, for these samples is a function of the carrier concentration. κ varies from a high of 6.0 for the sample with $P^* = 20 \times 10^{20}$ cm^{-3} to a low of 3.9 for a sample with $P^* = 12.8 \times 10^{20}$ cm^{-3}. The temperature dependence of H_{c2} is found to obey the Gorkov prediction. Dissert. Abstr.

N68-32311 National Lending Library for Science and Technology, Boston Spa (England).
THE PHOTOMECHANICAL EFFECT IN IONIC CRYSTALS [FOTOMEKHANICHNII EFEKT V IONNIKH KRISTALAKH]
M. Ya. Horidko, P. P. Kuzmenko, and M. M. Novikov May 1968 9 p refs Transl. into ENGLISH from Ukr. Fiz. Zh. (Kiev), v. 11, no. 9, 1966 p 1016–1021
(RTS-4486) Available from Natl. Lending Library, Boston Spa, Engl.: 12s 6d

A study was made to establish if the photomechanical effect exists in ionic crystals in a similar manner to that which is evident in semiconductive crystals. The specimens and experimental methods are discussed, and the results are analyzed in detail. The work reveals that the photomechanical effect in crystals of NaCl, KCl, and LiF has a magnitude of approximately 30 percent in all cases. The temperature zone for the occurrence of the photomechanical effect was established, and it is shown that the effect occurs up to temperatures of 120°C. The depth of the layer to which the photomechanical effect occurs was also established, and it appears to be much greater than that in semiconductor crystals. In KCl for example, the depth of softening of the layer amounts to 19 microns. It is shown that the photomechanical effect is probably conditioned by increase in dispersion of edge dislocations exposed to light. C.T.C.

N68-32312 National Lending Library for Science and Technology, Boston Spa (England).
INFLUENCE OF PLASTIC DEFORMATION ON THE SATURATION MAGNETIZATION OF FERROMAGNETIC NICKEL-COPPER AND NICKEL-CHROMIUM ALLOYS [VPLIV PLASTICHNOI DEFORMATSI NA MAGNICHENIST' NASICHENNYA FEROMAGNITNYKH NIKEL'OVO-MIDNIKH I NIKEL'OVO-KHROMISTIKH SPLAVIV]
I. Ya. Dekhtyar and O. P. Chudakov Feb. 1968 14 p refs Transl. into ENGLISH from Ukr. Fiz. Zh. (Kiev), v. 12, no. 5, 1967 p 812–818
(RTS-4391) Available from Natl. Lending Library, Boston Spa, Engl.: 17s 6d

Studies are presented of (1) saturation magnetization change effects on alloys having different copper contents but which are ferromagnetic at room temperature, and (2) the change in Curie point on deformation. Nickel alloys having copper contents of 0, 5, 10, 15, 17, 20, 22, 26, and 28 percent were investigated. It is concluded that the change in saturation magnetization in alloys is causes by the influence of crystal structure defects produced on deformation, and by the influence of the character and degree of close range order. In a number of cases the effect of close range order outweighs the effects caused by the fine crystal structure such as occurs in plastic deformation. C.T.C.

N68-32313 National Lending Library for Science and Technology, Boston Spa (England).
THE CONNECTION OF HYSTERESIS LOSSES WITH THE HYSTERESIS OF MAGNETO-STRICTION IN ROTATING MAGNETIC FIELDS [SVYAZ' POTER' NA GISTEREZIS S GISTEREZISOM MAGNITOSTRIKTSII VO VRASCHAYUSHCHIKHSYA MAGNITNYKH POLYAKH]
V. S. Afoshin Jun. 1968 6 p refs Transl. into ENGLISH from Izv. Vysshikh Uchebn. Zavedenii, Fiz. (Tomsk), v. 12, 1967 p 147–149
(RTS-4583) Available from Natl. Lending Library, Boston Spa, Engl.: 5s

Consideration is given to the relation between the hysteresis of ferromagnetic bodies in rotating magnetic fields and magnetostrictive hysteresis. Specimens of grain oriented nickel and silicon steel were used. Measurements were made of the magnetostriction, and the mechanical moments acting on the nickel specimen were recorded on photographic film for both clockwise and counterclockwise rotation of the field. The results are shown in the form of curves for the dependence of the losses and the magnetostrictive hysteresis on the field H. C.T.C.

N68-32314 National Lending Library for Science and Technology, Boston Spa (England).
PHOTO-E.M.F. OF N-CDS P-Cu_xS_y HETEROJUNCTIONS [FOTO-E.R.S. U GETEROPEREKHODAKH N-CDS–Cu_xS_y]
S. Yu. Pavelets and G. A. Fedorus Dec. 1967 7 p refs Transl. into ENGLISH from Ukr. Fiz. Zh. (Kiev), v. 11, no. 6, 1966 p 686–688
(RTS-4278) Available from Natl. Lending Library, Boston Spa, Engl.: 7s 6d

Three techniques for producing heterojunctions are examined. In one, CdS films were obtained by sputtering CdS powder onto a molybdenum substrate at a pressure of 1.5×10^{-2} torr. Film resistances were varied from 10^{10} ohms to a few ohms by varying the degree of indium doping in the CdS. It was noted that when a thin layer of copper was deposited by evaporation a barrier was produced and photovoltage was observed. In low resistance films the barrier was formed only when a thin layer of sulfur was deposited on the surface of the CdS film before depositing the copper. The n–CdS–p–Cu_xS_y heterojunctions were obtained by vacuum deposition of CuS on CdS films and single crystals. The copper sulfide was evaporated from the molybenum substrate at a pressure of $5 \cdot 10^{-5}$ torr. Monocromatic studies were conducted on the spectral distribution of the photovoltage of junctions obtained by CdS + Cu, CdS + S + Cu, and CdS + Cu_xS_y methods. The results confirm that when copper is applied to CdS without additional heat treatment, n–CdS–p–Cu_xS_y heterojunctions are produced. M.G.J.

N68-32324# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
HALL PICKUPS BASED ON THIN LAYERS OF INDIUM ANTIMONIDE [DATCHIKI KHOLLA NA OSNOVE TONKIKH SLOYEV ANTIMONIDA INDIYA]
K. V. Shalimova, A. M. Gulyayev, A. S. Shnitnikov, and O. B. Kalinina 16 Nov. 1967 8 p refs Transl. into ENGLISH from the Publ. "Poluprovodnikovyye Pribory i Ikh Primeneniye. Sbornik Statey" No. 13, 1965 p 306–311
(FTD-HT-23-996-67; AD-671590)

Hall pickups prepared by K. G. Gunters three-temperature method were developed for use as functional elements in electronic systems and for measuring the strength and configuration of magnetic fields. Thin films of indium antimonide were used as semiconductor layers, with dimensions ranging from 0.4 x 1.2 mm to 4 x 8 mm. Four different types of pickups were developed. The first type, designed for use as functional elements in multipliers, dividers, and detectors, had overall dimensions of 10 x 15 mm with a semiconductor layer 3 x 3 mm in area. Two other types of pickups were designed for measuring magnetic fields and for use in automatic devices. The fourth type measured 1.2 x 0.4 mm and was developed for measuring the configuration of magnetic fields. The resistance of the pickups was less than 1000 ohm; sensitivity was 70-180 microv/oe. The relationships between the parameters of the pickups and temperature, conditions of heat transfer, and magnetic field strength were studied. The pickups were successfully used in magnetic field measurements, especially, between stators and rotors of electric machines. TAB

N68-32338 California Univ., Los Angeles.
NUCLEAR SPIN-LATTICE RELAXATION IN MAGNETIC INSULATORS
David Edmund Beeman, Jr. (Ph.D. Thesis) 1967 94 p
Available from Univ. Microfilms: HC $4.80/MF $3.00 Order No. 67-14292

First order nuclear spin-lattice relaxation arises in magnetic insulators when a nuclear spin directly interacts with one or more spin waves via the hyperfine interaction. We consider here some second order two and three magnon processes which arise when a virtual magnon, emitted in the direct process, is scattered by thermal magnons via the exchange interaction or the magnetic dipole-dipole interaction. This is possible, since the spectrum of the virtual magnon is lifetime broadened to include the nuclear spin resonance frequency. The second order three magnon process, arising from the four magnon exchange interaction, enhances the three magnon process relaxation rate by a factor of eight in ferromagnets, and results in a temperature dependent enhancement of about an order of magnitude in antiferromagnets. Three magnon terms in the dipole-dipole interaction may induce a two magnon process in both ferromagnets and antiferromagnets, which is of significance when the first order Raman process is forbidden.
Dissert. Abstr.

N68-32345 Missouri Univ., Columbia.
COMPUTER SOLUTION FOR THE NONLINEAR PARTIAL DIFFERENTIAL EQUATIONS FOR A P-N DIODE
Mangal Prasad Verma (Ph.D. Thesis) 1967 81 p
Available from Univ. Microfilms: HC $4.40/MF $3.00 Order No. 67-13873

To get the overall picture of the dynamics of the holes and electrons in the semiconductor, two continuity equations, one for the holes and one for the electrons, together with the Poisson's equation, are necessary to be solved. These three equations (without neglecting any term or terms) form a set of three nonlinear partial differential equations which should be solved simultaneously. An attempt has been made in this dissertation to solve this set of three nonlinear partial differential equations using a set of boundary and initial conditions on the digital computer (IBM 1620). To use this set of equations on the computer, the finite difference approximations for the partial differential equations have been used with various scheme of approximations. The solutions obtained here are stable for all times in the linear case. The solution obtained when some nonlinear terms are introduced is stable for some time. An observation of the solution curves indicates that the instability occurs at a latter time at the terminal points in the nonlinear case.
Dissert. Abstr.

N68-32354 Case Inst. of Tech., Cleveland, Ohio.
PULSED FIELD DE HAAS-VAN ALPHEN EFFECT IN ZINC
James Donald Beasley (Ph.D. Thesis) 1967 113 p
Available from Univ. Microfilms: HC $5.60/MF $3.00 Order No. 67-16058

The larger Fermi surface cross sections in zinc have been studied using the pulsed field de Haas-van Alphen effect. The periods observed have been assigned to orbits on the Fermi surface in the first, second, and third Brillouin zones. Their angular dependence has been compared favorably with a modified Orthogonalized Plane Wave model calculated by Harrison. Magnetic breakdown effects appear to have been significant in making possible some of the observed cross sectional areas for the zinc Fermi surface.
Dissert. Abstr.

N68-32406 National Lending Library for Science and Technology, Boston Spa (England).
DEFECTS IN THE FLUX LINE LATTICE OF TYPE 2 SUPERCONDUCTORS
H. Trauble and U. Essmann [1968] 21 p refs Transl. into ENGLISH from Phys. Status Solidi (Frankfurt am Main), v. 25, 1968 p 373-393
(M-7179) Available from Natl. Lending Library, Boston Spa, Engl.

The lattice of flux lines in type II superconductors contains lattice defects, as known from crystal physics, namely dislocations, stacking faults, "point" defects, etc. Moreover, strong elastic distortions and lattice bendings occur. By examples, obtained by direct observations, the various lattice defects are described and classified.
Author

N68-32412* Kyoto Univ. (Japan). Research Inst. for Fundamental Physics.
A SYSTEMATIC APPROACH TO THE PROBLEMS OF RANDOM LATTICES. 1: A SELF-CONTAINED FIRST-ORDER APPROXIMATION TAKING INTO ACCOUNT THE EXCLUSION EFFECT
Fumiko Yonezawa Jun. 1968 42 p refs
(RIFP-71) CFSTI: HC $3.00/MF $0.65

A systematic method of approximation for the electronic state of a randomly doped lattice or a vibration spectrum of a disordered lattice is given in the present series of work by means of an investigation of the one-electron Green's function. In the present article, an exact form of the first-order self-energy is, with the help of a diagrammatic consideration, evaluated on rigorously including the "exclusion effect". The resulting "exact" first-order self-energy agrees with the lowest-order approximant of the "total" first-order self-energy which has been previously obtained and satisfies the same equation derived for the case of lattice vibrations. It is also identical with the approximation developed by other investigators. Thus, one of the objects of the analysis given in the present work is to offer a mathematically correct interpretation of these methods. A systematic way to proceed to higher-order approximations is discussed.
Author

N68-32413 Pennsylvania State Univ., University Park.
THE STRUCTURE AND PROPERTIES OF CLEAVED SEMICONDUCTOR SURFACES
Wendell Phillips Noble, Jr. (Ph.D. Thesis) 1967 113 p
Available from Univ. Microfilms: HC $5.60/MF $3.00 Order No. 67-15408

Recent observations have suggested that cleaved silicon surfaces exhibit electrical inhomogeneities and possibly structural disorder. It was therefore proposed to investigate electrical surface properties in order (1) to ascertain the extent to which such disorder effects are present in different materials with varying dopings, (2) to determine whether these effects can be avoided by improvements in cleavage techniques, (3) to determine whether disorder inferred from electrical measurements is related to visible surface features, and (4) to evaluate the effect of the disorder on surface barrier height and thus its effect on measurements involving large surface areas. The electrical properties of silicon and gemanium surfaces, cleaved under various dielectric liquids, were studied as a function of position on the surface by probing with a mercury jet contact (80μ diameter). On the basis of these measurements it was concluded that there is considerable disorder present in the form of dislocations introduced during the cleavage process.
Dissert. Abstr.

N68-32420 National Lending Library for Science and Technology, Boston Spa (England).
CONTRIBUTION TO THE THEORY OF THERMAL-ACTIVATION MAGNETIC VISCOSITY OF MULTIDOMAIN PARTICLES OF FERROMAGNETIC MATTER. 1 [K TEORII TERICHESKI-AKTIVATSIONNOI MAGNITNOI VIAZKOSTI MNOGODOMENNYKH CHASTITS FERROMAGNETIKA. 1]

V. S. Averyanov May 1968 19 p refs Transl. into ENGLISH from Fizika Zemli, v. 8, 1967 p 74–82
(RTS-4476) Available from Natl. Lending Library, Boston Spa, Engl: 22s/6d

Neel's theory of thermal-activation magnetic viscosity fails to explain the experimentally determined differences between the hysteresis type and therma-activation type processes in the magnetization of ferromagnetic matter. In this paper the validity of some of Neel's assumptions in the development of his theory is examined. It is shown that in his calculations the neglect of the exchange portion E_W of the free energy of the thermal fluctuations in spontaneous magnetization M_S is incorrect. When E_W is taken into account, it becomes possible to determine the relation between the magnetic portion E_m of the free energy of the thermal fluctuations and the shape of the body in which the fluctuations are investigated. Author

N68-32476 National Lending Library for Science and Technology, Boston Spa (England).
THE EFFECT OF FLUCTUATION OF THE INTERNAL MAGNETIC FIELD ON THE MOSSBAUER EFFECT
L. Pal [1968] 54 p refs Transl. into ENGLISH from Acta Phys. Acad. Sci. Hung. (Budapest), v. 23, no. 2, 1967 p 161–183 In RUSSIAN and ENGLISH
(M-7119) Available from Natl. Lending Library, Boston Spa, Engl.

The effect of directional fluctuations of the internal magnetic field on the shape of Mössbauer spectra was investigated. It was found that for increasing frequency of fluctuations, first the lines of hyperfine splitting broaden, then shift, and finally merge into a central line narrowing gradually as the frequency continues to increase. The disappearance of the splitting takes place when the frequency of the fluctuations exceeds the Larmor frequency of the lines involved. At the instant of coalescence the central line exhibits a substantial deviation from the Lorentzian shape. The position and width of each line as well as the mechanism of coalescence are appreciably affected by an external magnetic field. Author

N68-32520# Delaware Univ., Newark. Physics Dept.
DESORPTION OF OXYGEN FROM VIRGIN CdS SINGLE CRYSTALS
Karl W. Boer Jun. 1968 15 p refs
(Grant Nonr (G)-4336-(00)
(TR-24; AD-671878)

Typical desorption data of amu 16 from virgin CdS single crystals is presented for two classes of crystals as determined by their electrical properties. Thermal desorption energies are found in the energy range of 0.87 eV to > with temperatures of maximum desorption between 405K to > 700K. Surface average of amu 16 can be over two monolayers. Several desorption peaks are attributed to oxygen. Author (TAB)

N68-32532 Cornell Univ., Ithaca, N. Y.
THE PROPAGATION OF HELICON WAVES UNDER CONDITIONS OF NONLOCAL CONDUCTIVITY
James Richard Houck (Ph.D. Thesis) 1967 128 p
Available from Univ. Microfilms: HC $6.20/MF $3.00 Order No. 67-16361

The work described is primarily concerned with the attenuation of helicons in the nonlocal regime. The theory of helicon attenuation is developed including both collisional damping and nonlocal effects. The theory predicts a strong nonlocal attenuation for helicons propagating at an angle to the external field, B_o. This damping is similar to the Landau or transit time damping associated with other types of plasma excitations. A series of experiments designed to measure the attenuation of helicon waves propagating in alkali metals is described. The alkali metals were chosen because of the simplicity of the electronic structure. A detailed quantitative comparision between theory and experiment shows very good agreement. The free electron theory is used to calculate the effect of collisions on the nonlocal dispersion of helicons for propagation along B_o. A series of pulse propagation experiments are described in detail. These experiments are used to check the c.w. attenuation measurements. Dissert. Abstr.

N68-32557 National Lending Library for Science and Technology, Boston Spa (England).
CORRELATION BETWEEN THE CONDUCTIVITY AND MICROHARDNESS OF SILICON
V. O. Drozdov, L. O. Mozgova, and O. L. Rvachov 30 Sep. 1967 5 p refs Transl. into ENGLISH from Ukr. Fiz. Zh. (Kiev), v. 11, no. 10, 1966 p 1118–1119 In RUSSIAN and ENGLISH
(EE-TRANS-1681) Available from Natl. Lending Library, Boston Spa, Engl.

The relation of microhardness to conductivity in silicon was investigated. It is shown that when studying this relationship account must in some cases be taken of the sizes of the impurity atoms as well as of the conductivity value. Author

N68-32614 National Lending Library for Science and Technology, Boston Spa (England).
THE BREAKDOWN VOLTAGE OF DIFFUSED P-N JUNCTIONS IN SILICON [ZUR DURCHBRUCHSPANNUNG DIFFUNDIERTER PN-UEBERGAENGE IN SILIZIUM]
W. Moench 11 Jan. 1968 19 p refs Transl. into ENGLISH from Solid-state Electron. (London), v. 10, 1967 p 1085–1092 In GERMAN and ENGLISH
(EE-TRANS-1716) Available from Natl. Lending Library, Boston Spa, Engl.

Measurements of the breakdown voltage of diffused p-n junctions, taking into consideration impurity concentration gradients at the diffused junction, are discussed in comparison with previous measurements of this type and with breakdown voltage measurements for alloyed p-n junctions in silicon, and for abrupt junctions. The p-n junctions were produced by diffusing gallium from a Ga-Si source at a temperature of 1250°C. Diffusion was carried out in sealed quartz containers filled with purified argon with a room temperature pressure of 0.3 metric atmospheres. EC

N68-32626 National Lending Library for Science and Technology, Boston Spa (England).
GRAPHIC METHOD FOR DETERMINATION OF OPTICAL CONSTANTS OF SINGLE CRYSTAL SEMICONDUCTORS BY TRANSMISSION MEASUREMENT [GRAFICHNIY METOD VIZNACHENYIA OPTICHNIKH KONSTANT MONOKRISTALICHNIKH NAPIVPROVODNIKI V ZA DOPOMOGYU VIMIRIVANIA PROPUSKANIA]
K. D. Tovstyuk and O. M. Borets' Jun. 1968 10 p refs Transl. into ENGLISH from Ukr. Fiz. Zh. (Kiev), v. 7, no. 12, 1962 p 1285–1291
(RTS-4511) Available from Natl. Lending Library, Boston Spa, Engl.: 20s

Transmission optical constants of two semiconducting single crystal plates were measured graphically to determine the absorption coefficient and surface reflection. Multiple reflections were accounted for and a transcendental equation was evolved, and values for transmissions from .05 to .60 and surface reflection from .05 to .90 were tabulated. The graphic method permits construction of curves at intermediate points. M.W.R.

N68-32638# Johns Hopkins Univ., Baltimore, Md. Dept. of Physics.
EXCITED STATE ABSORPTION FROM METASTABLE STATES OF IONS IN CRYSTAL

Jacob W. Huang Mar. 1968 105 p refs
(Contract DA-31-124-ARO(D)-339)
(TR-2; AROD-5400-12-P; AD-671713)

A spectrometer system for studying optical absorption from metastable states of ions in crystal is described. Absorption cross sections for excited state absorption from the metastable (2)E state in Al2O3:Cr(3+) were measured at temperatures of 300K, 105K and 40K in the wavelength region from 2300A to 7100A. The excited state population was obtained at 105K and 40K by using the vibronics of the (4)T2 ground state absorption band. Excited state absorption from the (2)E state was observed in MgO:Cr(3+) with a strong peak at 2800A. Strong excited state absorption bands were found near 4750A, 3170A, 2850A and 2470A of a pumped SrF2:Sm(2+) crystal and near 4750A, 3280A, 2740A and 2470A of a pumped SrCl2:Sm(2+) crystal. These bands were explained to be transitions from (5)Do(4f(6)) to higher quintet states of 4f(5)5d configuration. Author (TAB)

N68-32641# United Kingdom Atomic Energy Authority, Harwell (England).
GALLIUM ARSENIDE
J. Frey Mar. 1968 16 p refs
(AERE-R-5757) CFSTI: HC $3.00/MF $0.65

This review sets out the properties and applications of GaAs. Current ion implantation work is also discussed. Author (NSA)

N68-32644# California Univ., Irvine. Dept. of Physics.
THEORETICAL STUDY OF SOME DYNAMICAL PROPERTIES OF PERFECT AND IMPERFECT CRYSTALS
Final Scientific Report, 1 Feb. 1966–31 Jan. 1968
Alexei A. Maradudin 16 Apr. 1968 7 p refs
(Grant AF-AFOSR-1080-66)
(AFOSR-68-1545; AD-671964)

In summary, there has been a great deal of research activity supported by AF-AFOSR Grant 1080-66 during the two year period from February 1, 1966 to January 31, 1968. This research activity has touched on a wide variety of problems in solid state theory, and has contributed to our understanding of several phenomena of physical and theoretical interest in perfect and imperfect crystals. Author (TAB)

N68-32646 California Inst. of Tech., Pasadena.
DYNAMIC PROCESSES IN MAGNETIC THIN FILMS-DOMAIN WALL MOTION AND FERROMAGNETIC RESONANCE
Carl Elliott Patton, III (Ph.D. Thesis) 1967 207 p
Available from Univ. Microfilms: HC $9.45/MF $3.00 Order No. 67-14353

The objective of the present investigation has been threefold: (1) To characterize domain wall motion in thin ferromagnetic films experimentally and to determine what film properties influence wall mobility. (2) To investigate ferromagnetic resonance relaxation in thin films over a wide range of temperature, frequency, and thickness and to determine what physical relaxation processes contribute to the resonance linewidth. (3) To correlate the losses for wall motion with relaxation processes for ferromagnetic resonance. Even though phenomenological damping parameters for the two processes, wall motion and resonance, are quite different (at 300°K), there is a definite connection between the losses. Changes in the wall mobility between 300°K and 77°K have been measured for films exhibiting, to varying degrees, the above linewidth effect. From these mobility and linewidth data, the losses for wall motion were found to be directly related to the losses for resonance from 300°K to 77°K. There is a definite connection between the relaxation processes which are important for wall motion and those involved in resonance. Dissert. Abstr.

N68-32647 Oregon Univ., Eugene.
MANY BODY EFFECTS ON DIAMAGNETISM
Michael Angelos Philippas (Ph.D. Thesis) 1967 90 p
Available from Univ. Microfilms: HC $4.60/MF $3.00 Order No. 67-16177

The effect of the Coulomb interaction between the electrons on the diamagnetic susceptibility is investigated for the case of low temperatures and weak magnetic fields. The method of Green's functions is employed to calculate an expression for the ground state energy <E>, which is valid through the random phase approximation and second order in the applied constant magnetic field. The formalism is applied to an electron gas (made electrically neutral by the presence of a background positive charge), and then generalized to a simple model of a solid. Dissert. Abstr.

N68-32690 Oregon Univ., Eugene.
QUANTUM LIMIT MAGNETOCONDUCTIVITY
Gene Alan Barnes (Ph.D. Thesis) 1967 126 p
Available from Univ. Microfilms: HC $8.20/MF $3.00 Order No. 67-16149

The static transverse electrical conductivity at low temperatures in a magnetic field was calculated for the case of electron-impurity scattering. Calculations were restricted to the quantum limit case, where the magnetic field is so strong that all electrons occupy the lowest Landau level. In one-electron Hamiltonian for the system, the impurity is represented by a potential V(r), which has cylindrical symmetry about the direction (z) of the magnetic field. When the solutions of the Schroedinger equation were expanded in basis functions which included the Landau states, a set of coupled, linear one-dimensional equations in z was obtained. Due to the Z-axis reflection symmetry, the solutions could be classified as symmetric or antisymmetric. A finite number of the equations in this set were solved numerically on an IBM 360 machine to obtain the phase shifts corresponding to the two types of solutions, as required by the Kubo–Miyake formula. Dissert. Abstr.

N68-32750# Massachusetts Inst. of Tech., Cambridge.
THE EFFECT OF THERMAL DESORPTION OF WATER ON SURFACE STATES ON GERMANIUM IN ULTRAHIGH VACUUM
Jerzy Sochanski and Harry C. Gatos Jun. 1968 17 p refs
(Contract Nonr-3963(05))
(TR-11; AD-671834)

Large signal alternating current field effect experiments in the dark and under illumination were carried out on real germanium surfaces following a heat treatment in ultrahigh vacuum. After prolonged heating (about 10 hours) at 520 degrees K, the surfaces were slightly p-type, exhibiting 3 to 5 times higher density of traps than prior to heating. Higher temperatures (560 degrees K, 600 degrees K and 640 degrees K) rendered the surfaces more p-type, but caused essentially no change in the density of traps. The observed changes of the electrical properties were correlated to the results of desorption experiments in which a mass spectrograph was employed. The total surface charge was found to increase linearly with the amount of desorbed water (0.00025 negative elementary charges per desorbed water molecule). Author (TAB)

N68-32770 Nebraska Univ., Lincoln.
STORED ENERGY IN IRRADIATED SODIUM CHLORIDE
James Marion Bunch (Ph.D. Thesis) 1967 142 p
Available from Univ. Microfilms: HC $8.80/MF $3.00 Order No. 67-15811

A differential thermal analysis technique has been used to measure the stored energy in x-rayed and gamma-irradiated NaCl containing F-center concentrations as high as 1.8×10^{18} cm^{-3}, and relatively small concentrations of M, R, and higher aggregate centers. For nominally pure samples, the rate of release of stored energy as a function of sample temperature has peaks at

135°C, 250°C, and 350°C, which have been tentatively explained in terms of transformations of various defects produced by the radiation. The total stored energy from x-ray pure samples was found to vary approximately linearly with the F-center concentration plus twice the M-center concentration, for F center concentrations between 3×10^{17} cm^{-3} and 13×10^{17} cm^{-3}. The total energy from samples which were gamma-irradiated well beyond the saturation of the F-center concentration at 7×10^{17} cm^{-3} was about 20% larger than that from x-rayed samples with identical F-center concentrations. Discert Abstr.

N68-32790 Rochester Univ., N. Y.
TWO-PHOTON ABSORPTION SPECTROSCOPY IN CdS AND OTHER MATERIALS
Paul Jerome Regensburger, Jr. (Ph.D. Thesis) 1967 166 p
Available from Univ. Microfilms: HC $7.80/MF $3.00 Order No. 67-13641

In this thesis two-photon processes are observed by studying the effect of an intense laser beam on the absorption spectrum of a material. The experiment consists of comparing the transmission of a sample in the absence and in the presence of intense optical radiation from a pulsed laser. The quantitative dependence of the minimum detectable laser induced absorption on the probe beam intensity, the saturation limit of the detector, the electronic band pass of the detection system and the thermal noise generated in the amplifier is discussed. The two-photon absorption spectrum of single-crystal CdS is measured using polarized light and precise geometry. Spectra are obtained both at room temperature and at liquid nitrogen. The experimental results are found to be in agreement with a theory of two-photon excitation of interband transitions developed by Braunstein when simplifying assumptions are made. The transitions are identified as "allowed-allowed" transitions on the basis of the shape of the absorption curve. Dissert. Abstr.

N68-32796 National Lending Library for Science and Technology, Boston Spa (England).
SURFACE PROPERTIES OF INTERNAL CONDUCTING SEMICONDUCTORS OF THICKNESS BELOW THE DEBYE'S SCREENING LENGTH [POVERKHNEVI VLASTYVOSTI NAPIVPROVIDNYKIV Z VLASNOYU PROVIDNISTYU PRI TOVSHCHYNAKH MENSHYKH DEBAYIVSKOYI DOVZHYNY EKRANUVANNYA]
L. S. Gasanov Jun. 1968 4 p refs Transl. into ENGLISH from Ukr. Fiz. Zh. (Kiev), v. 11, no. 5, 1966 p 555–557
(RTS-4689) Available from Natl. Lending Library, Boston Spa, Engl.: 7s 6d

Theoretical results of the investigations of surface properties of internal conducting semiconductors, obtained earlier, are generalized for the case of the specimen of terminal thickness. The results can also be used in the case of semiconductors with slightly ionized admixtures. The distribution of the potential electric field local and excess concentrations of current carriers are expressed by means of special functions (Jacobian elliptic functions and elliptic integrals). For the case of very small thicknesses approximations of accurate formulas and their relative errors are investigated. Author

N68-32798# National Bureau of Standards, Washington, D. C.
A BIBLIOGRAPHY ON METHODS FOR THE MEASUREMENT OF INHOMOGENEITIES IN SEMICONDUCTORS Final Report, Dec. 1966–Dec. 1967
Harry A. Schafft and Susan Needham Griffiss AFB, N. Y. RADC Jun. 1968 58 p
(Contract F30602-67-C-0105)
(RADC-TR-68-96; AD-671524)

About 130 papers which deal with the measurement techniques useful in detecting the type and location of various inhomogeneities, primarily in germanium and silicon, are listed with key words. The types of inhomogeneities considered are those in impurity concentration, resistivity, mobility, diffusion length, lifetime, surface conditions, crystal perfection, and p-n junctions. Some of the 22 effects or methods used to detect these inhomogeneities are: photovoltaic, electron voltaic, photoconductivity, one-, two- and four-point probe, spreading resistance, and voltage breakdown. There are three indexes: a reference tabulation according to key words, a reference tabulation according to methods or effects used to detect an inhomogeneity, and an author index. Author (TAB)

N68-32826# Commissariat a l'Energie Atomique, Grenoble (France).
MAGNETISM OF SOME RARE EARTH ELEMENTS AND IONIC COMPOUNDS UNDER PRESSURE
R. Pauthenet, D. Bloch, and F. Chaisse *In* Oak Ridge Natl. Lab. 6th Rare Earth Res. Conf. [1967] p 10–17 refs (See N68-32824 20-06)

Experiment results and discussion of the effect of pressure on magnetic ordering points and on the saturation magnetization of several polycrystalline rare earth elements and rare earth iron garnets are presented. Author (NSA)

N68-32827# Bell Telephone Labs. Inc., Murray Hill, N. J.
PROPERTIES OF THE RARE-EARTH METALS AND ALLOYS AT HIGH PRESSURES
D. B. McWhan *In* Oak Ridge Natl. Lab. 6th Rare Earth Res. Conf. [1967] p 18–28 refs (See N68-32824 20-06)

A review of recent measurements of the pressure dependence up to 85 kbar of the Néel and Curie temperatures, and crystal structures is given. The materials studied include: the elements Eu, Gd, Tb, Dy, and Ho; the Tb–Y alloy system; and a series of alloys with equal average DeGennes function. The initial slopes (dT/dP) are approximately proportional to the average DeGennes function. A polymorphic transition from a hexagonal-close-packed structure to a Sm-type structure was found with increasing pressure in many of these alloys. The Sm-type phase did not exhibit ferromagnetism but has two ordering temperatures. The higher ordering temperature of the Sm-type phase was 10% lower than that of the hcp phase, and the two ordering temperatures in the Sm-type phase differed by 17%. Author (NSA)

N68-32828# Texas Univ., Austin. Dept. of Chemical Engineering.
MAGNETIC AND ELECTRICAL PROPERTIES OF SOME Yb-Sb PHASES
R. E. Bodnar, H. Steinfink, and K. S. V. Narasimhan *In* Oak Ridge Natl. Lab. 6th Rare Earth Res. Conf. [1967] p 29–36 refs (See N68-32824 20-06)
(Grant NSF GK-1236)

A study of ytterbium valence variations in Sb–Yb alloys was made, based on magnetic susceptibility data. The magnetic susceptibility measurements were made in the range from 325 to 1.70°K using the Faraday technique. Only the YbSb phase exhibited near trivalent Yb. Yb_4Sb_3 exhibited a valence between 2 and 3, and Yb_9Sb_3 and $YbSb_2$ were divalent. NSA

N68-32829# Pittsburgh Univ., Pa. Dept. of Chemistry.
MAGNETIC AND CRYSTALLOGRAPHIC CHARACTERISTICS OF PRASEODYMIUM
K. H. Mader and W. E. Wallace *In* Oak Ridge Natl. Lab. 6th Rare Earth Res. Conf. [1967] p 36–47 refs (See N68-32824 20-06)

Susceptibilities (χ) and lattice parameters are reported for a series of praseodymium hydrides represented by the formula PrH_x in which x varies from 0.99 to 2.57. χ was measured from 4 to 300°K and at field strengths up to 21 kOe. The samples are two phase for $x < 1.85$. Curie–Weiss behavior was observed for all

samples above 100°K with slopes in fairly good agreement with that expected for an assemblage of free tripositive ions. Deviations occurred below 100°K. These are two kinds—negative for $x < 2.1$ and positive for $x > 2.1$. The deviations in the first case are small and are thought to result from the crystal field interaction. The positive deviations are ascribed to a change of valence for Pr from 3+ to 4+. Magnetic, electric, and crystallographic evidence is in accord with this postulate. There is no indication of magnetic ordering in the Pr hydrides at 4.2°K. This is attributed to weakness of the interactions and to the valence changes that reduce the atomic moment. Author (NSA)

N68-32830# General Electric Co., Schenectady, N. Y. Research and Development Center.
MAGNETIC BEHAVIOR OF RARE EARTH COMPOUNDS WITH SINGLET CRYSTAL FIELD GROUND STATE
Bernard R. Cooper *In* Oak Ridge Natl. Lab. 6th Rare Earth Res. Conf. [1967] p 48–57 refs (See N68-32824 20-06)

The susceptibility and high field magnetization expected for rare earth compounds with singlet crystal field ground state are discussed. In particular, the limitations of molecular field theory in treating exchange effects on the susceptibility, non-linear magnetization, and criterion for magnetic ordering in such systems are considered. Author (NSA)

N68-32831*# Rice Univ., Houston, Tex.
MICROWAVE ABSORPTION IN DYSPROSIUM SINGLE CRYSTALS
H. A. Blackstead and P. L. Donoho *In* Oak Ridge Natl. Lab. 6th Rare Earth Res. Conf. [1968] p 58–67 refs (See N68-32824 20-06)
(Grant NsG-6-59) CSCL 20L

Microwave power absorption was observed at a frequency of 9.8 GHz in single-crystal c-plane platelets of dysprosium at temperatures from 40 to 179°K. The rf magnetic field was aligned parallel to an a-axis (easy axis), and the dc magnetic field was aligned along a b-axis (hard axis), either perpendicular to the rf field or at an angle of thirty degrees to it. At temperatures below 85°K, and for temperatures from 86°K to approximately 110°K with $H_{dc} > H_c$, a strong resonance line with a width of approximately 1 kOe was observed. This resonance, predicted from spin-wave analysis, is apparently related to the strong six-fold basal-plane anisotropy, which is important below 110°K. With the dc field perpendicular to the rf field, and for temperatures above 110°K, there was no apparent field-dependence of the absorption for $H_{dc} < h_c$. At higher fields, however, the absorption increased rapidly, reaching a maximum at H_f, the field at which the fan structure collapsed to ferromagnetic alignment. With further increase of the field, the absorption then decreased linearly. No absorption was observed above 179°K, the temperature for the transition from the helicoidal spin structure to the paramagnetic state. Frequency-dependence studies are in progress in the range 8 to 25 GHz. Author (NSA)

N68-32832# Sandia Corp., Albuquerque, N. Mex.
NUCLEAR MAGNETIC RESONANCE MEASUREMENTS IN THE NaCl-TYPE RARE-EARTH GROUP VA INTERMETALLIC COMPOUNDS
E. D. Jones *In* Oak Ridge Natl. Lab. 6th Rare Earth Res. Conf. [1967] p 68–77 refs (See N68-32824 20-06)

Phosphorus nuclear magnetic resonance (NMR) was observed in the paramagnetic state of NaCl-type rare earth intermetallic compounds REP (RE = rare earth). The phosphorus Knight shifts were measured in the temperature range from 100 to 600°K. Analyzing the temperature-dependent Knight shifts in terms of a uniform-conduction electron spin polarization model yields values for the s–f exchange energy I'. The arsenic, antimony, and bismuth Knight shift data in SmAs, SmSb, and SmBi are also presented. For the Sm^{3+} compounds, theoretical predictions concerning the behavior of the temperature dependence of the Sm^{3+} (S(T)) are verified. Author (NSA)

N68-32833# Calgary Univ. (Alberta). Dept. of Physics.
EPR ANGULAR SPECTRA OF GADOLINIUM IN RARE-EARTH DOUBLE NITRATE SINGLE CRYSTALS
H. A. Buckmaster, J. C. Dering, and D. J. I. Fry *In* Oak Ridge Natl. Lab. 6th Rare Earth Res. Conf. [1967] p 78–88 refs (See N68-32824 20-06)

A systematic study of the 10-GHz electron paramagnetic resonance (EPR) spectra of the gadolinium ion (Gd^{3+}; ^8S) in isomorphic, diamagnetic lattices of hydrated, rare earth double nitrate single crystals is reported. These lattices are of the form $M'''_2 M''_3 (NO_3)_{12} \cdot 24\ H_2O$ where M''' is bismuth or lanthanum and M'' is zinc or magnesium. The ratio of Gd^{3+} to M''' ions was ≅0.1%. The experimental data for temperatures of 290 and 77°K are fitted to the phenomenological spin-Hamiltonian for C_{3i} symmetry. The angular dependence of the spectra showed substantial variations from that predicted, which were not reported previously. These variations were not inconsistent with C_{3i} symmetry but cannot be completely described by any spin-Hamiltonian of the above form. This raises doubts as to the usefulness of the spin-Hamiltonian formalism because the intrinsic symmetry of the terms is too high to describe the variations. Author (NSA)

N68-32834# Oak Ridge National Lab., Tenn. Solid State Div.
TEMPERATURE VARIATION OF Gd ESR SPECTRA IN CUBIC AND AXIAL CRYSTALS
M. M. Abraham, L. A. Boatner *In its* 6th Rare Earth Res. Conf. [1967] p 89–100 refs (See N68-32824 20-06)

The electron spin resonance of gadolinium was observed and the temperature variation of the splitting was studied in single crystals of CeO_2, ThO_2, CaF_2, and CaO, where the symmetry of the local crystalline field was cubic. Similar measurements were made on single crystals of $La(C_2H_5SO_4)_3 \cdot 9H_2O$, $LaCl_3$, and $LaBr_3$ in which the symmetry of the local field was axial. Absolute signs of "spin" Hamiltonian parameters were determined from the relative intensity of the resonance lines at low temperature. Author (NSA)

N68-32835# New Mexico State Univ., University Park.
THE M SERIES X-RAY EMISSION LINES OF THE RARE EARTHS
A. F. Burr *In* Oak Ridge Natl. Lab. 6th Rare Earth Res. Conf. [1967] p 101–111 refs (See N68-32824 20-06)

A review of the wavelengths and energy levels assigned to the M series X-ray transitions of the rare earths shows that the width and pronounced structure of the Mα line has made the determination of its wavelength difficult and has introduced some uncertainty in the value to be given to the N(VI,VII) energy level. A program of selecting the most probable values for energy levels and wavelengths of X-ray lines was extended by using modified Moseley diagrams to include the information contained in adjacent elements. Revised Mα and Mβ wavelengths are given for a number of rare earths as well as revised N(VI,VII) energy levels. Further information is given on the origin of the structure of the Mα line in the rare earth region of the periodic table. Author (NSA)

N68-32840# Sheffield Univ. (England).
MAGNETIC PROPERTIES OF DYSPROSIUM
R. G. Jordan *In* Oak Ridge Natl. Lab. 6th Rare Earth Res. Conf. [1967] p 166–174 refs (See N68-32824 20-06)

The magnetic properties of several single crystals of dysprosium were investigated along the principal directions of the hcp structure over the temperature range from 4 to 300°K, and in applied

magnetic fields up to 18 Koe. The measurements in the basal plane agreed in general with the previous work. Along the c direction, a small spontaneous moment was observed, appearing at 125 ± 2, 89 ± 3, and 88 ± 4°K for the three crystals studied. The corresponding spontaneous moments at 0°K are 1.9 ± 0.4, 2.7 ± 0.3, and 2.6 ± 0.3 emu./gm. An analysis of the results would seem to indicate that the transition from antiferromagnetism to ferromagnetism is controlled by the strong dependence of the indirect exchange interaction with lattice dimensions. On the basis of this analysis the ferromagnetic c axis lattice parameter was calculated for 90°K ≤ T ≤ 179°K. Author (NSA)

N68-32847# Radio Corp. of America, Princeton, N. J.
RARE EARTH CHEMISTRY OF LASERS
P. N. Yocom *In* Oak Ridge Natl. Lab. 6th Rare Earth Res. Conf. [1967] p 228–238 refs (See N68-32824 20-06)

It is shown that the important quantities for obtaining laser action are the frequency of the transition, the fluorescent linewidth, the dipole moment matrix element of the transition, and the cavity properties, and how these quantities are interrelated. It is then pointed out how both di- and trivalent lanthanide ions can provide the needed properties under suitable conditions. The subject of crystal lasers is presented on the basis of the charge on the ion replaced by the lanthanide ion. The properties and preparation of divalent lanthanide ions are presented as well as the charge compensation of the trivalent ions in divalent sites. Sensitization in crystalline hosts is described and a short, qualitative discussion of the line broadening presented. The glasses containing lanthanide ions that show laser action are described and the effects that a glass matrix have on the properties of the lanthanide ions discussed. Short descriptions of the rare earth chelate systems that show laser action are given, along with mention of the inorganic, nonaqueous, liquid laser system. Author (NSA)

N68-32848# Du Pont de Nemours (E. I.) and Co., Wilmington, Del. Central Research Dept.
TRIVALENT EUROPIUM ION FLUORESCENCE IN NON-RARE EARTH OXIDE HOSTS
Hans J. Borchardt *In* Oak Ridge Natl. Lab. 6th Rare Earth Res. Conf. [1967] p 239–248 refs (See N68-32824 20-06)

Attempts were made to dope a variety of non-rare earth oxides with Eu^{3+}. Of 19 oxides tried only ThO_2 gave a bright phosphor. Failure of the others is attributed to low Eu^{3+} solubility. $(ThO_2)_{0.98}$ $(EuF_3)_{0.02}$ is a highly efficient phosphor with a quantum efficiency of about 0.64 under 2537 Å excitation. It is reported to be the first high efficiency Eu^{3+} phosphor not to contain a second rare earth ion and to have such a low optimum Eu^{3+} concentration. Author (NSA)

N68-32849# Army Electronics Command, Fort Belvoir, Va. Night Vision Lab.
ENERGY TRANSFER IN CRYSTALS DOUBLY DOPED WITH RARE EARTHS
L. Esterowitz, J. Bahler, and J. Noonan *In* Oak Ridge Natl. Lab. 6th Rare Earth Res. Conf. [1967] p 249–258 refs (See N68-32824 20-06)

It was demonstrated that the infrared quantum counter (IRQC) fluorescence may be increased by using two species of rare earth impurity ions. The effects on the energy cascade were studied as the sensitizer (Yb^{3+}) concentration was increased. In particular, level bypassing of the Ho^{3+} (activator), $^5F_5$, state was attributed to a resonant energy cross-relaxation process. Author (NSA)

N68-32851# Lockheed Missiles and Space Co., Palo Alto, Calif. Research Lab.
CATHODOLUMINESCENCE OF RARE EARTH-ACTIVATED YTTRIUM OXIDE
R. A. Buchanan, K. A. Wickersheim, J. L. Weaver, L. E. Sobon, and E. E. Anderson *In* Oak Ridge Natl. Lab. 6th Rare Earth Res. Conf. [1967] p 271–282 refs (See N68-32824 20-06) (Contract AT(04-3)-674)

The current interest in rare earth-activated phosphors stimulated a general survey of the cathodoluminescent properties of rare earths in yttrium oxide. Y_2O_3: Eu and Gd_2O_3: Eu are phosphors whose cathodoluminescent properties were previously reported. Their sharp line emission spectra, superior performance, and chemical stability are some of the characteristics of these materials. Relevant properties of the other rare earth activators in yttrium oxide were investigated. Those properties of special interest reported are: optimum activator concentrations for electron excitation, emission spectra from 2500 Å to 3 microns, lifetimes of principal emission lines, and efficiencies. The materials studied were in the form of powders precipitated as oxalates and fired in air to form the phosphors. These phosphor powders were loaded into a demountable electron-gun vacuum system and excited with 9-kV electrons at beam current densities of about 2.5 μ amp per cm^2. Author (TAB)

N68-32853# Laboratoire d'Electrostatique et du Metal, Grenoble (France).
MAGNETIC PROPERTIES AND MAGNETIC STRUCTURES OF THE TCo_3
R. Lemaire, R. Pauthenet, J. Schweizer, and I. Silvera *In* Oak Ridge Natl. Lab. 6th Rare Earth Res. Conf. [1967] p 295–296 (See N68-32824 20-06)

The magnetization of the rare earth–cobalt compounds TCo_3 was measured at fixed temperatures between 2 and 1000°K in magnetic fields that varied up to 29,000 Oe. The Curie temperatures lie in the range from 300 to 612°K; they increase rapidly with the value of the spin moment of the associated rare earth. NSA

N68-32854# United Kingdom Atomic Energy Authority, Harwell (England).
NEUTRON SCATTERING FROM PARAMAGNETIC TERBIUM
J. W. Cable, M. F. Collins, and A. D. B. Woods *In* Oak Ridge Natl. Lab. 6th Rare Earth Res. Conf. [1967] p 297–306 refs (See N68-32824 20-06)

The energy distribution of neutrons scattered from a single crystal of terbium at about 660°K (T_n=230°K) was studied as a function of momentum transfer (Q). The measurements were carried out using both the twin rotor time-of-flight spectrometer and the triple axis spectrometer at Harwell. The distributions were approximately Gaussian in shape with an additional tail, which is believed not to be connected with the paramagnetic scattering but more likely with multiple or phonon scattering. The second moment of the energy distribution, as determined from fitted Gaussian curves, yield exchange interactions that are consistent with those deduced from the spin wave dispersion curves in the ferromagnetic state as measured by Moller and Houmann. The distributions contain a large Q independent component, which arises from the anisotropy energy. Typical values of $(\langle h^2\ \omega^2 \rangle)^{1/2}$ near zone boundaries are ≈3.2 MeV. Author (NSA)

N68-32855# Technical Univ., Copenhagen (Denmark).
MAGNON DISPERSION RELATION IN RARE EARTH METALS FROM INELASTIC NEUTRON SCATTERING
H. Bjerrum Moller (AEK Res. Estab. Risø), J. C. Gylden Houmann, and A. R. Mackintosh *In* Oak Ridge Natl. Lab. 6th Rare Earth Res. Conf. [1967] p 307–309 refs (See N68-32824 20-06)

The magnon dispersion relations in Tb and a Tb–10% Ho alloy were studied by inelastic neutron scattering. In pure Tb a tendency toward spiral ordering was observed. When 10% Ho was added, this tendency was considerably enhanced and the spiral structure was stable over a greater temperature range. In the

alloy a strong coupling between magnons and transverse phonons propagating in the c-direction, which leads to mixed excitations and a splitting apart of the dispersion curves, was observed. NSA

N68-32865# Los Alamos Scientific Lab., N. Mex.
SELF-IRRADIATION EFFECTS IN A CERIUM ALLOY CONTAINING 15 AT. % PLUTONIUM
R. O. Elliott, W. N. Miner, and F. W. Clinard, Jr. *In* Oak Ridge Natl. Lab. 6th Rare Earth Res. Conf. [1967] p 405-415 refs (See N68-32824 20-06)

Four samples of an α-phase cerium alloy (85 at. % CE-15 at. % Pu) were stored at 20°K for 1076 hr. The plutonium used in making the samples was variably enriched with Pu^{238} isotope to provide four different levels of irradiation. Accumulation of lattice damage due to the alpha activity of plutonium was followed by periodically measuring the electrical resistivities of the samples during storage at low temperature. Annealing of damage was then followed from 20° to 350°K, by the isochronal method. Results are discussed in terms of the nature of the lattice damage. Author

N68-32872# Tokyo Univ. (Japan). Inst. of Solid State Physics.
EFFECT OF THE s-f EXCHANGE IN DILUTE ALLOYS
Kei Yosida *In* Oak Ridge Natl. Lab. 6th Rare Earth Res. Conf. [1967] p 471-481 refs (See N68-32824 20-06)

It is well established that the s-f exchange interaction between the conduction electrons and the localized spin of 4f electrons plays a decisive role in the localized magnetic and electrical properties of rare earth metals and alloys. The s-f exchange interaction has an effect particularly in dilute alloys of rare earth in nonmagnetic metals. Since Kondo succeeded in explaining the resistivity minimum in dilute alloys of Mn and Fe in noble metals the effect of the s-f or s-d exchange on the electrical resistivity of dilute alloys was investigated in detail by Suhl, Arbikosov, Nagaoka, and many others. These investigations are reviewed in connection with dilute alloys of rare earths and recent experiments on this anomalous effect are also briefly mentioned. Author (NSA)

N68-32873# Massachusetts Inst. of Tech., Cambridge. National Magnet Lab.
BAND STRUCTURE, FERMI SURFACE AND PHYSICAL PROPERTIES OF THE RARE-EARTH METALS
A. J. Freeman *In* Oak Ridge Natl. Lab. 6th Rare Earth Res. Conf. [1967] p 482-486 (See N68-32824 20-06)

A review is given of the present understanding of some of the electric, magnetic, and optical properties of rare earth metals based on recent ab initio energy band calculations. Author (NSA)

N68-32874# Iowa State Univ. of Science and Technology, Ames. Dept. of Physics.
POSITRON ANNIHILATION IN RARE EARTH SINGLE CRYSTALS
R. W. Williams and A. R. Mackintosh (Technical Univ., Denmark) *In* Oak Ridge Natl. Lab. 6th Rare Earth Res. Conf. [1967] p 487-494 refs (See N68-32824 20-06)

The angular correlations of photons emitted when positrons annihilate with electrons in single crystals of the rare earth metals, Y, Gd, Tb, Dy, Ho, and Er and also in single crystals of certain alloys were measured. A comparison of the results for Y with the calculations of Loucks shows that the independent-particle model gives a good approximation to the angular distribution, although correlation effects probably smear out some of the details. The angular distributions in the c direction in the paramagnetic phases show a rapid drop at low angles followed by a hump, and these features are associated with rather flat electron and hole regions of Fermi surface normal to the c axis. There is a strong correlation between the size of the hump and the ability of the magnetic metals to form a periodic magnetic structure. In the spiral phase of Ho, the hump is much reduced, indicating that the flat electron and hole surfaces are substantially modified by the magnetic ordering. The implications of these results on the relation between the conduction electrons and the magnetic order in rare earth metals are discussed. Author (NSA)

N68-32875# Brookhaven National Lab., Upton, N. Y.
HYPERFINE INTERACTION IN RARE EARTH METALS AND COMPOUNDS
G. Brunhart *In* Oak Ridge Natl. Lab. 6th Rare Earth Res. Conf. [1967] p 495-505 refs (See N68-32824 20-06)

The possible origins of the effective magnetic hyperfine fields at the nuclei of the rare earth elements stimulated considerable theoretical and experimental interest. Although several contributions to the effective field must be considered, in general the magnetic field produced by the 4f electrons dominates. Kondo calculated the 4f contribution for several rare earth elements and predicted very large hyperfine fields, in some cases as much as several thousand kilo-oersted. Exceptions are Gd^{3+} and Eu^{2+}, which have a half-filled 4f shell and whose angular momentum is zero. In these two cases the dominant contribution comes from exchange polarization, i.e., the interaction of the core electrons with unpaired outer electrons. In the case of metallic solids there is also the possibility that the polarization of the conduction electrons might cause significant contribution. The nuclear polarization that often can be quite easily achieved in rare earth elements is directly dependent on the effective magnetic field and can be measured using polarized neutrons as a probe. Measurements were made on a series of rare earths, from Sm through Tm, using polarized neutrons and polarized targets, and values for the magnitude and sign of the hyperfine constants and effective fields were obtained. Author (NSA)

N68-32876# Argonne National Lab., Ill.
TEMPERATURE DEPENDENCE OF THE HYPERFINE FIELD IN RARE EARTH-GOLD COMPOUNDS
B. D. Dunlap, A. E. Dwight, G. M. Kalvius, and C. W. Kimball *In* Oak Ridge Natl. Lab. 6th Rare Earth Res. Conf. [1967] p 506-509 refs (See N68-32824 20-06)

Ordered binary alloys of gold with various rare earths (Yb, Tm, Er, and Ho) were investigated by observing the Mössbauer hyperfine fields in ^{166}Er, ^{169}Tm, ^{171}Yb, and ^{197}Au nuclei. In these compounds the Au spectra are asymmetric doublets, which are roughly independent of temperature. In some cases the rare earth Mössbauer spectra show magnetic splittings and evidence of electronic relaxation effects. Author (NSA)

N68-32877# Naval Ordnance Lab., White Oak, Md.
MAGNETOSTRICTION IN DILUTE RARE EARTH IRON GARNETS
A. E. Clark, J. J. Rhyne, and E. R. Callen *In* Oak Ridge Natl. Lab. 6th Rare Earth Res. Conf. [1967] p 510-521 refs (See N68-32824 20-06)

The conventional single-ion theory of magnetoelastic coupling successfully accounted for the temperature dependence of the huge magnetostriction observed in the heavy rare earth metals. It also accounted for the temperature dependences in rare earth iron garnets. These measurements were extended to low temperatures on GdIG and on a series of partially substituted Dy $Y_{1-x}IG$ single crystals. It is shown that: the magnetostriction is linear in Dy concentration, establishing a single-ion source, and conventional statistical theory, which ignored crystal field effects, can be preserved for some magnetostrictive modes, but must be modified for others. Author (NSA)

N68-32878# Argonne National Lab., Ill. Metallurgy Div.
ELASTIC MODULI OF Gd METAL
E. S. Fisher and D. Denver *In* Oak Ridge Natl. Lab. 6th Rare Earth Res. Conf. [1967] p 522–533 refs (See N68-32824 20-06)

The elastic moduli of Gd single crystals were measured over the temperature range from 4 to 923°K. The results indicate that some degree of magnetic ordering exists between T_c and 330°K. A sharp transition is indicated at 286°K for compressional modes and at 289°K for shear modes. It is suggested that a change in direction of the magnetic moments occurs abruptly at 218°K. The Debye θ calculated from the 4°K data is 181.5°K. This, together with the Debye θ calculated for Er (θ = 191°K) suggests that the Debye θ of the trivalent rare earth metals is linearly related to the atomic weights. The anisotropy ratio, $A = c_{44}/c_{66}$, increases with temperature in the paramagnetic phase as expected for hcp metals that transform to the bcc structure at high temperatures. Author (NSA)

N68-32879# Argonne National Lab., Ill.
THE HEAT CAPACITY OF SCANDIUM FROM 1 TO 23°K
Howard E. Flotow and Darrell W. Osborne *In* Oak Ridge Natl. Lab. 6th Rare Earth Res. Conf. [1967] p 534–545 refs (See N68-32824 20-06)

The heat capacity of a well-characterized, polycrystalline scandium sample was measured from 0.9 to 23°K. The results are in reasonable agreement with previous measurements below 4°K, except that a small anomalous addendum to the heat capacity was detected. This anomaly follows a T^{-2} dependence down to 2.9°K, rises to a maximum of about 1.3 mJ deg^{-1} (g at. Sc)$^{-1}$ near 1.2°K, and has an associated entropy of 3.2 mJ deg^{-1} (g at. Sc)$^{-1}$. It is believed to be due to small concentrations of magnetic impurities found in the sample. An evaluation of the results from 2.9 to 8.4°K gave γ = 10.66 ± 0.10 mJ deg^{-2} (g at.)$^{-1}$ and θ = 359.5 ± 4.2°K. A table of smoothed heat capacities and thermodynamic functions for scandium at selected temperatures between 5 and 298.15°K is presented. Author (NSA)

N68-32880# Pittsburgh Univ., Pa. Dept. of Chemistry.
CRYSTAL FIELD HEAT CAPACITIES OF $PrNi_2$ AND PrBi
M. Dixon, M. Aoyagi, R. S. Craig, and W. E. Wallace *In* Oak Ridge Natl. Lab. 6th Rare Earth Res. Conf. [1967] p 546–555 refs Sponsored by Army Res. Office (See N68-32824 20-06)

Heat capacities of $PrNi_2$, $CeNi_2$, PrBi, and LaBi were measured from 1.5 to 300°K. The first two compounds are cubic Laves phases while the latter two have the NaCl structure. One of the objectives of this investigation was to evaluate the crystal field heat capacity of $PrNi_2$. The heat capacity of $CeNi_2$ was measured in order to obtain an estimate of the vibrational contribution, the difference in heat capacity between $CeNi_2$ and $PrNi_2$ being taken as the crystal field heat capacity of the latter. The excess heat capacity of $PrNi_2$ was observed as a broad maximum at about 12°K. The excess heat capacity below 30°K was considerably larger than expected from the crystal field contribution. The heat capacity of $CeNi_2$ exhibited an anomaly in the liquid helium temperature range. It is suggested that the anomaly results from a small population of trivalent Ce ions, which begin to order at about 2.5°K. The crystal field heat capacity of PrBi was found by taking the difference in heat capacity between PrBi and LaBi. The crystal field heat capacity thus found appeared as a somewhat broader anomaly than predicted from the limiting susceptibility. Author (NSA)

N68-32881# Cincinnati Univ., Ohio. Dept. of Physics.
ON THE EXPERIENCE OF AN ANTIFERROMAGNETIC PHASE IN RFe_7 COMPOUNDS
H. Weik, E. Susedik, and M. Turner *In* Oak Ridge Natl. Lab. 6th Rare Earth Res. Conf. [1967] p 556–567 refs (See N68-32824 20-06)

Results of previous neutron-diffraction studies on peritectic compounds of Pr and Nd with Fe of the type RFe_7 suggested the existence of an antiferromagnetic phase beyond the magnetically measured Curie temperatures. In order to prove or disprove this supposition, measurements of the specific heat and electric resistivity were performed with an arc melted and homogenized Nd–Fe sample of the same composition and treatment as used in the neutron-diffraction studies. The specific heat measurements, performed between room temperature and 110°C, exhibited a relative maximum at 56°C, in agreement with the magnetically determined Curie temperature of 53°C, and show with increased sample temperature a further increase, indicating a ferromagnetic-antiferromagnetic transition. Measurements of the electric resistivity were in agreement with this and seemed to indicate a Néel temperature at about 300°C. The results support newer magnetic measurements of other RFe_7 compounds in which signs of antiferromagnetism were found. Author (NSA)

N68-32882# National Research Council of Canada, Ottawa (Ontario). Div. of Pure Chemistry.
ANALYSES OF LOW-TEMPERATURE HEAT CAPACITIES OF THE RARE-EARTH METALS
J. A. Morrison and D. M. T. Newsham *In* Oak Ridge Natl. Lab. 6th Rare Earth Res. Conf. [1967] p 568–580 refs (See N68-32824 20-06)

Low-temperature heat-capacity data for rare earth metals were reanalyzed and somewhat different results were obtained for individual contributions to the total heat capacity of several of the metals. Since the proportions of the different contributions vary from metal to metal, and with temperature, the advantages of a graphical analysis as opposed to a standardized (computer) analysis are stressed. For each metal considered, the analysis gives the coefficient of the electronic contribution, and the coefficient of the leading term in the series expansion for the nuclear-hyperfine contribution, to an accuracy comparable to that of the experiments. For Yb and Lu, estimates of the lattice contributions were obtained. For only four of the metals (Pr, Nd, Eu, and Tm) is the magnitude of the magnetic contribution to the heat capacity large enough for its form to be determined. For these metals, the magnetic heat capacity seems to have an exponential temperature dependence. Author (NSA)

N68-32883# Southern Univ., Baton Rouge, La. Dept. of Physics.
THE OPTICAL AND ELECTRICAL PROPERTIES OF YTTERBIUM THIN FILMS
Ogba A. Okorie and Sohan Singh (Howard Univ.) *In* Oak Ridge Natl. Lab. 6th Rare Earth Res. Conf. [1967] p 581–590 refs (See N68-32824 20-06)

In addition to reflectance and transmittance, the thickness and resistivity of Yb thin films deposited by vacuum evaporation were measured in the spectral region 0.5 to 6.8 microns. From these data, the refractive index, the extinction coefficient, the absorption coefficient, the carrier density, and the types of carriers as well as their relaxation time were calculated. Drude theory applied well between 1 to 3.5 microns. Hagen–Ruben's relation also applied at intervals. The infinite wavelength index of refraction is 10.9 while the indirect transition is 1.8 eV. The mean free path of the carriers is 236Å, the carrier velocity is 3.17×10^7 cm/sec, and the relaxation time is 7.45×10^{-14} sec. Empirically, the reflectance and the transmittance are related by an expression of the form $R = Ae^{-BT}$. Similar expression was determined for the reflectance and the wavelength. Author (NSA)

N68-32884*# Auburn Univ., Ala. Dept. of Physics.
ELECTRICAL CONDUCTION AND DIELECTRIC BREAKDOWN IN THIN EVAPORATED LAYERS OF SEVERAL RARE EARTH OXIDES
A. T. Fromhold, Jr., W. D. Foster, T. A. Harbuck, and R. B. Mosley *In* Oak Ridge Natl. Lab. 6th Rare Earth Res. Conf. [1967] p 591-602 refs (See N68-32824 20-06)
(Grant NAS8-20081) CSCL 07D

Some electrical measurements at 300°K are reported for thermally evaporated oxides 300 to 6000 Å in thickness of the rare earth metals La, Ce, Pr, and Nd. Thin evaporated aluminum electrodes were utilized to impress voltages in the range zero to 80 volts across the oxide layers; electric fields as large as 5×10^6 volts/cm could be reached prior to destructive dielectric breakdown. Low field ($E<10^4$ volts/cm) current-voltage characteristics were almost linear. High field ($E\leq10^5$ volts/cm) current-voltage behavior was initially quite erratic, since the layers experience many nondestructive dielectric breakdowns. After voltage cycling, the current-voltage characteristics tended to become stable, reproducible, and nonlinear, with current densities ranging from one microampere/cm^2 to one ampere/cm^2. At 10^{-6} torr the initial current-voltage characteristics were less erratic and could be stabilized by voltage cycling more readily than those measured at ambient pressure. Author (NSA)

N68-32885# Air Force Systems Command, Wright-Patterson AFB, Ohio. AF Materials Lab.
PERMANENT MAGNET PROPERTIES OF YCo_5 POWDERS
K. J. Strnat, J. C. Olson, and G. Hoffer *In* Oak Ridge Natl. Lab. 6th Rare Earth Res. Conf. [1967] p 603-614 refs (See N68-32824 20-06)

Ferromagnetic intermetallic compounds of the type RCo_5 between several rare earths and cobalt were found to be promising candidates for a technological application as fine particle permanent magnets. Experiments with powders of YCo_5 prepared by mechanical milling are described. Intrinsic coercivities up to ≈3000 Oe were achieved for particle sizes near 5μ, but further size reduction unexpectedly lowered H_c again. This is explained as the result of plastic deformation damage in the crystallites. Initial experiments suggest that two measures can reduce the overmilling effect and may allow attainment of higher coercive forces and consequently higher energy products: grinding below room temperature and high-vacuum annealing of the powders. Oxidation of the smallest particles seemed to occur during grinding unless air was excluded and this resulted in a further reduction of H_c. However, particles in an epoxy matrix and powder compacts did not change their properties appreciably during several months of aging at room temperature. Author (NSA)

N68-32886# Massachusetts Inst. of Tech., Cambridge. National Magnet Lab.
HIGH FIELD MAGNET MOMENT MEASUREMENTS IN SINGLE CRYSTAL RARE-EARTH METALS
S. Foner *In* Oak Ridge Natl. Lab. 6th Rare Earth Res. Conf. [1967] p 615-617 refs (See N68-32824 20-06)

Results are briefly summarized for high field magnetic moment measurements in single crystals of Gd, Ho, Er, Dy, Eu, Sm, and Tm. Measurements as a function of temperature and field (dc to 170 kG) were made along principal axes. Included in the findings mentioned are: (1) gadolinium saturates at low fields (<60kG) for all principal directions. (2) Ho, Dy, and Er approach saturation along the easy axis in most cases, but complete saturation is not achieved along the hard axes for the fields available. (3) As expected, there is a large anistropy in Dy. (4) The Tm moment along the easy axis approaches that expected for saturation of the Tm^{3+} ion at high fields. Low values of magnetic moment even at 70kG are mainly due to very high anisotropy rather than impurities. Impurity effects may, however, be the determining factor in the complex behavior presented earlier for Eu. (5) Data to 150 kG at 4.2°K show a constant susceptibility rather than a field dependent one, in contrast to earlier low field polycrystalline data. E.C.

N68-32887# Iowa State Univ. of Science and Technology, Ames. Inst. of Atomic Research.
FREQUENCY DEPENDENCE OF MAGNETIC LOSSES IN Ho IN THE NEIGHBORHOOD OF THE CURIE TEMPERATURE
B. C. Gerstein and F. Olander *In* Oak Ridge Natl. Lab. 6th Rare Earth Res. Conf. [1967] p 618-626 refs (See N68-32824 20-06)

The frequency dependence of imaginary and real susceptibilities of polycrystalline Ho was measured in the neighborhood of the ferromagnetic ordering temperature. The nature of the χ'-ω-T and χ''-ω-T surfaces was defined in the range $10\leq T\leq 25$°K $22\leq\omega\leq 110$ Hz. For the sample measured, the resonant frequency for domain wall motion lay below 22Hz indicating that ac susceptibilities of Ho measured above 10 Hz will not agree with dc measurements. The results were fitted to a driven oscillator model and were found to correlate more closely with a model in which effective mass is ignored than with one in which it is not, but the agreement was not completely satisfactory. Author (NSA)

N68-32888# Iowa State Univ. of Science and Technology, Ames. Inst. for Atomic Research.
ELECTRICAL RESISTIVITY AND SEEBECK EFFECT OF THULIUM SINGLE CRYSTALS
Sam Legvold and L. Roger Edwards *In* Oak Ridge Natl. Lab. 6th Rare Earth Res. Conf. [1967] p 627-634 refs (See N68-32824 20-06)

Single crystals of Tm were grown by the strain anneal technique. The electric resistivity and the Seebeck coefficients were measured along the three crystallographic directions $\langle11\bar{2}0\rangle$, $\langle10\bar{1}0\rangle$, and $\langle0001\rangle$ as a function of temperature from 4 to 300°K. The electric resistivity results indicate a Néel temperature of 57.5°K with no evidence for other magnetic transitions. The Seebeck coefficients also indicated a Néel temperature of 57.5°K. However, the Seebeck coefficient of the $\langle0001\rangle$ crystal showed a second transition at 32°K, which is in good agreement with low field magnetic susceptibility measurements on polycrystalline Tm. Neutron diffraction data of Koehler et al., indicated the transition to be about 38°K. Both measurements exhibited a significant anisotropy between the $\langle0001\rangle$ direction and the basal plane. Author (NSA)

N68-32889# Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France).
ELECTRONIC STRUCTURE OF RARE EARTH MONOCARBONS [STRUCTURE ELECTRONIQUE DES MONOCARBURES DE TERRES RARE]
R. Lallement *In* Oak Ridge Natl. Lab. 6th Rare Earth Res. Conf. [1967] p 635-652 refs In FRENCH (See N68-32824 20-06)

Studies were made of the electric conductivity, thermoelectric behavior, and magnetic susceptibility of the rare earth carbides. By analysis of the results of these studies, the electronic structure of the carbides could be determined. NSA

N68-32948 Oregon Univ., Portland.
VARIATIONAL METHODS FOR THE ANISOTROPIC HEISENBERG LINEAR CHAIN AT NONZERO TEMPERATURE
John Thomas Hunt, Jr. (Ph.D. Thesis) 1967 90 p
Available from Univ. Microfilms: HC $4.60/MF $3.00 Order No. 67-16166

The work presented here deals with the anisotropic Heisenberg linear chain at nonzero temperature in both the ferromagnetic and antiferromagnetic cases. The system is investigated by two different methods, both of which yield a rigorous upper bound to the free

energy at all temperatures and for all values of anisotropy and exchange. In the first method, which is an application of the Bogolubov variational principle, one minimizes this upper bound with respect to certain variational parameters and thus obtains the best approximation to the free energy consistent with the variational ansatz. The second method, which is due to Wentzel, involves a truncation of the original Hamiltonian and an exact calculation of the free energy of this truncated or model Hamiltonian in the thermodynamic limit. The internal energy and the specific heat are then calculated using the expression for the free energy obtained from both approximation methods. Dissert. Abstr.

N68-32966 Rutgers Univ., New Brunswick, N. J.
ON THE THEORY OF MAGNETIC SHIELDING WITH APPLICATION TO SOLID AND GASEOUS XENON
Joan Barbara Lurie (Ph.D. Thesis) 1967 148 p
Available from Univ. Microfilms: HC $7.00/MF $3.00 Order No. 67-14734

Magnetic shielding was studied with particular attention to features of the problem arising in the solid phase and the results were applied to an evaluation of the shielding in solid and gaseous xenon. A second order perturbation calculation including the effects of nearest and next nearest neighbors in an fcc lattice is performed to obtain the shielding at a given atom in a static lattice. The exchange and overlap integrals which appear in the result are evaluated in a manner which introduces no new approximations once the wave functions have been stated in analytic form. The effect of the vibrations of the lattice, present even at T=0°K, is evaluated in the quasiharmonic approximation; thermal expansion is included by using experimentally measured values of the lattice parameter. An approximate calculation of the effect of anharmonicity is also carried out. The effect of lattice vibrations and thermal expansion leads to a temperature dependent local field shift. The theoretical results for the shift in both gas and solid are compared with the available experimental data. Dissert. Abstr.

N68-32991# Grumman Aircraft Engineering Corp., Bethpage, N. Y. Research Dept.
OPTICAL PROPERTIES OF TRANSITION METALS AT INFRARED WAVELENGTHS
J. Reichman and C. Feldman Aug. 1968 19 p refs Presented at the Am. Phys. Soc. Spring Meeting, Berkeley, 18–21 Mar. 1968 Submitted for Publication
(RE-338J)

Knowledge of the spectral reflectance and emittance properties of transition metals are required to determine their emission and absorbtion of thermal radiation. In order to extrapolate experimental values of these optical properties to longer wavelengths it is desirable to have a theoretical model to fit the available data. The validity of a two band model was investigated to analyze these properties for 14 transition metals at infrared wavelengths. Optimum values for the model parameters were obtained from the available experimental data by a least-squares minimization technique through the use of a computer program. Although good model fits are obtained for almost all of the transition metals under consideration, the model parameters found are not always unique. This is due, primarily, to limited wavelength information. One band model fits, when applicable, were also done. It is found in all instances that the corresponding two band model fits give better agreement with experiment. A listing of the one and two band model parameters used for the fits is given as well as graphical model fit comparisons with experiment. Author

N68-33020*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
DETERMINATION OF RESISTIVITY AND HALL COEFFICIENT OF SEMICONDUCTING MATERIALS BETWEEN 80°K AND 375°K
R. C. Ruff 6 Aug. 1968 43 p refs
(NASA-TM-X-53763) CFSTI: HC $3.00/MF $0.65 CSCL 20L

The apparatus is capable of determining resistivity over a range from approximately 3×10^{-6} ohm-cm to 10^{5} ohm-cm and Hall coefficient from 0.2 cm^3/coulomb to $10^{10}cm^3$/coulomb with an absolute error less than 5 percent. An introduction to the resistivity and Hall effect is presented with special emphasis on certain other basic solid state properties which can be calculated from the resistivity and Hall coefficient data according to the band theory of semiconductors. The results from resistivity and Hall coefficient determinations on a specimen of silver–antimony–iron–telluride ($AgSb_{0.8}Fe_{0.2}Te_2$) thermoelectric material are presented along with the charge carrier concentration and the Hall mobility which are quantities derived from the measured values. The results from resistivity determinations on a series of eight experimental electrical brush materials are presented. Author

N68-33028# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics.
SPIN-PHONON INTERACTION IN FERROMAGNETIC CRYSTALS [SPIN-FONONNOE VZAIMODEISTVIE V FERROMAGNITNYKH KRISTALLAKH]
S. V. Tyabilkov and H. Konvent 1968 26 p refs In RUSSIAN
(JINR-P4-3794)

It is shown that the spin–phonon interaction in the ferromagnetic crystals in the weak coupling approximation between phonon and spin subsystems leads to the renormalization of the phonon frequency due to the magnetization and to the renormalization of the energies of spin excitations due to the thermal motions of atoms. As a result, the velocity of sound is renormalized and the Curie point rises in the high-temperature region. The phonon subsystem was studied, taking into account some anharmonic effects, which may lead to the instability of the lattice. For calculation, the double-time temperature-dependent Green functions method is used. Author (NSA)

N68-33051 Clark Univ., Worcester, Mass.
ORGANIC SEMICONDUCTION
Robert Woodrow Wilson (Ph.D. Thesis) 1967 103 p
Available from Univ. Microfilms: HC $5.20/MF $3.00 Order No. 67-13553

Orthophenanthroline was examined as a function of purity. In the impure compound two conduction paths were noted. A plot of all E_a values vs all log δ_o values resulted in a straight line. The slope of this line was in agreement with a proposed model of barrier penetration. The model successfully predicts the large differences in observed δ_o values, the effects of impurities and the significant change in the activation energy for supercooled, liquid orthophenanthroline. Dissert Abs

N68-33062 Johns Hopkins Univ., Baltimore, Md.
THE MOESSBAUER EFFECT FOLLOWING COULOMB EXCITATION OF THE EVEN-EVEN ISOTOPES OF YTTERBIUM
John Stark Eck (Ph.D. Thesis) 1967 95 p
Available from Univ. Microfilms: HC $4.80/MF $0.65 Order No. 67-13794

A series of Mössbauer experiments have been carried out on the even-even isotopes of ytterbium. Coulomb excitation was employed to populate the first excited states of Yb^{172}, Yb^{174} and Yb^{176}, while a radioactive source of Tm^{170}, which decays to Yb^{170}, was used to perform similar experiments on Yb^{170}. All experiments were performed with both targets (sources) and absorbers near liquid helium temperature. The Coulomb excitation Mössbauer experiments employed a beam of 3-MeV protons obtained from a Van de Graaff accelerator. Using metallic targets (or absorbers), which exhibit no hyperfine interaction,

conjunction with Yb_2O_3 absorbers (or targets), fairly well resolved spectra exhibiting the quadrupole interaction of the Yb nucleus in Yb_2O_3 were obtained. Since the electric field gradient at the nucleus in Yb_2O_3 is not known, absolute measurements of the nuclear quadrupole moments could not be extracted from the measured hyperfine energy splittings. However, by taking suitable ratios of the hyperfine interaction energies, the relative quadrupole moments among isotopes were obtained. Dissert Abstr.

N68-33083# Istituto Superiore di Sanita, Rome (Italy). Laboratori di Fisica.
LECTURES ON ELECTRON PARAMAGNETIC RESONANCE
M. W. P. Strandberg 6 Oct. 1967 55 p refs Lectures given at Rome, 9–15 Sep. 1967
(ISS-67/34)

These lectures give the theoretical and experimental basis for understanding the phenomenon of electron paramagnetic resonance. After an introduction in which the systems of interest for EPR are specified along with the behavior of the susceptibility complex in the neighborhood of resonance, consideration is given to the problem of the Hamiltonian spin applied to the circuit approximation called crystal field theory. The third lecture deals with the problem of thermal equilibrium between the spin degree of freedom of the papamagnetic crystal and the lattice vibrations. The fourth lecture discusses the techniques which reveal the paramagnetic resonance signals and finally an allusion is made to other basic problems which can be attacked with these kinds of measurements. Author (NSA)

N68-33097# Michigan Univ., Ann Arbor.
THE ROLE OF CROSS RELAXATION IN THE EXTRA ENDOR SPECTRUM OF VANADIUM IN TUTTON SALT CRYSTALS
Joseph LeFevre Horner (Ph.D. Thesis) 1967 128 p refs
(Contract AT(11-1)-1112)
(COO-1112-161) CFSTI: HC $3.00/MF $0.65

An investigation was made of the ENDOR (electron nuclear double resonance) spectrum of the paramagnetic complex VO^{2+} imbedded in a diamagnetic host crystal of the Tutton salt $Zn(NH_4)_2(SO_4)_26H_2O$. In a normal ENDOR spectrum, either two or four lines are observed, depending on whether one of the two outermost EPR transitions or an inner EPR transition is induced. In the present case, up to fourteen ENDOR lines are observed. A calculation of the nuclear sublevels of the system, made from the rhombic spin Hamiltonian using perturbation theory through the second order, reveals that the extra ENDOR lines arise from transitions occurring among all fourteen nuclear sublevels. This breakdown of the normal ENDOR phenomenon can be understood in terms of interactions among neighboring vanadium atoms. The extra ENDOR lines were studies by measuring their transient response to the removal of the nuclear rf power, T_{REC}, as a function of temperature (4.2 and 2.34°K) and paramagnetic ion concentration (0.75 to 0.08%V; Zn by weight). The concentration is measured by a colorimetric analysis procedure. Author (NSA)

N68-33104*# Northrop Corp., Hawthorne, Calif. Corporate Labs.
EFFECTS OF IMPURITIES ON CARRIER LIFETIME IN BULK SOLAR-CELL MATERIAL Quarterly Report
Aug. 1968 19 p refs Prepared for JPL
(Contracts NAS7-100; JPL-952256)
(NASA-CR-96272: NCL-68-45R) CFSTI: HC $3.00/MF $0.65
CSCL 20L

Information was gathered regarding the feasibility of employing certain impurities as dopants in silicon. On the basis of this information the effects of Li, Na, Be, Cl and Al as dopants and very high oxygen concentrations in both n and p-type material will be investigated. Crystals containing each of these impurities except Li are being prepared. The diffusion of Li into relatively thick slabs of crucible-grown Si containing As or P was investigated. These experiments have demonstrated an apparent loss of Li from the surface during heating in vacuum. Isochronal annealing studies were performed on samples following Co^{60} gamma irradiation. The results indicate that the annealing behavior is dose dependent. Author

N68-33107 Northwestern Univ., Evanston, Ill.
PRECIPITATION IN THE Fe–Mo SYSTEM
Harris Leon Marcus (Ph.D. Thesis) 1967 204 p
Available from Univ. Microfilms: HC $9.25/MF $3.00 Order No. 67-15285

A Mossbauer effect study of precipitation in binary iron base Mo alloys and some precipitation hardenable steels gave a good insight into the reactions taking place. Where is it applicable the Mossbauer effect is a particularly convenient and powerful method for studying precipitation. It was possible in this study to determine directly the volume fraction of Fe_2Mo and thus it was not necessary to infer the extent of precipitation from other measurements as is often the case. The precipitation reaction of Fe_2Mo is a two dimensional diffusion controlled growth of rod-like platelets with an activation energy for the process of 59 Kcal. When the reaction goes to completion the volume fraction of Fe_2Mo directly gives the solvus composition. Dissert. Abstr.

N68-33138 Georgia Univ., Athens.
HIGH RESOLUTION SPECIFIC HEAT OF ANTIFERROMAGNETIC $MnCl_24H_2O$ NEAR ITS NEEL POINT
George Sumter Dixon, Jr. (Ph.D. Thesis) 1967 43 p
Available from Univ. Microfilms: HC $3.00/MF $3.00 Order No. 67-16212

The specific heat of the antiferromagnet $MnCl_2{\cdot}4H_2O$ was measured to within 5×10^{-6}°K of its Neél temperature $T_N = 1.622 \pm 0.001$°K. These measurements are consistent with existence of a singularity at T_N of the form $Log(T_N\text{-}T)$ to within 10^{-4} °K of the transition. This result is in agreement with estimates from the Ising model. Deviations from this law in the range from 10^{-4} to 5×10^{-6} °K are attributed to strains and imperfections in the crystal. Dissert. Abstr.

N68-33211# Michigan Univ., Ann Arbor.
STUDIES OF THE ACOUSTOELECTRIC EFFECT, ULTRASONIC ATTENUATION AND TRAPPING IN CADMIUM SULFIDE
Victor Eugene Henrich (Ph.D. Thesis) 1967 771 p refs
(Contract AT(11-1)-1112)
(COO-1112-157) CFSTI: HC $3.00/MF $0.65

A study of ultrasonic attenuation and electron trapping in cadmium sulfide single crystals by means of the acoustoelectric effect is reported. The acoustoelectric current waveforms generated when a burst of 30-MHz ultrasound, short compared to the sample, travels through it are studied. Ultrasonic attenuation was measured as a function of conductivity in five CdS samples. By varying the conductivity, it was possible to determine the electronic and lattice parts of the attenuation separately. All but one of the crystals studied showed spatial inhomogeneity, and it was necessary to formulate a model for the nonuniformity in order to explain the observed acoustoelectric waveforms. The model agreed fairly well with the data on most samples and gave excellent quantitative agreement for one crystal. The ultrasonic attenuation due to electrons was found to be accurately described by the theory of Hutson and White, and lattice attenuations of about 2 db/cm were measured. In addition to the attenuation measurements, the magnitude of the acoustoelectric current gives information about trapping parameters. On three samples there was no evidence for the presence of traps, but on one a strong effect was found. The data could be explained very well by the existence of a trap .39 eV below the conduction band with a density of 3.6×10^{15} cm^{-3}. Author (NSA)

N68-33228*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
ELECTRON SPIN RESONANCE OF LITHIUM-DIFFUSED SILICON
F. E. Geiger Washington Aug. 1968 28 p refs
(NASA-TR-R-290) CFSTI: HC$3.00/MF$0.65 CSCL 20L

Electron paramagnetic resonance was studied in floating-zone, lithium-diffused silicon. The resonances observed were identified as the result of Li-O complexes. The g-factor for the Li-O complex with the magnetic field H_0 in the ⟨100⟩ direction was found to be in good agreement with the calculated value obtained from the principal g-factors determined by Feher for crucible-grown silicon. Instrument sensitivity allowed the recording of Li-O and phosphorus donor hyperfine structure, thus permitting the Li-O concentration to be determined and the oxygen concentration in floating-zone silicon to be estimated. Irradiation of floating-zone, lithium-diffused silicon emptied the phosphorus donor levels and about 54 percent of the Li-O levels into deep traps; however, no new centers were found, although an unidentified structure was observed at approximately g=2.006. The lithium-diffused sample of 0.16 ohm-cm resistivity gave a narrow (0.9 oersted), stress-sensitive resonance line. The resonance split into a doublet in the ⟨100⟩ direction. The resonance was attributed to lithium donor electrons in a ground state and donor wave functions arising from single conduction electron valleys. Author

N68-33309# Los Alamos Scientific Lab., N. Mex.
LATTICE DYNAMICS OF GALLIUM PHOSPHIDE
John L. Yarnell, John L. Warren, Robert G. Wenzel, and Paul J. Dean (Bell Telephone Labs., Inc., Murray Hill, N. J.) 1968 19 p refs Presented at the Symp. on Inelastic Neutron Scattering, Copenhagen
(Contract W-7405-ENG-36)
(LA-DC-9228; CONF-680501-4) CFSTI: HC$3.00/MF$0.65

Dispersion curves for phonons propagating in the [100], [110], and [111] directions in gallium phosphide have been measured using a three-axis neutron-diffraction spectrometer operating in the constant-Q mode. The sample was a pseudo single crystal which was prepared by gluing together 38 single-crystal plates of gallium phosphide 1 to 2.5 cm in diameter and ≈0.07 cm thick. Rocking curves for eight reflections symmetrically distributed in the plane of the experiment had full widths at half maximum in the range 0.52 to 0.58° and were approximately Gaussian in shape. A group theoretic analysis of the lattice dynamics of this structure and a shell model fit to the measured dispersion curves are presented. Various optical properties of gallium phosphide are discussed in terms of the phonon dispersion curves. In particular, the phonons which assist indirect electronic transitions are identified as those at the zone boundary in the [100] direction (symmetry point X) in agreement with theoretical and experimental indications that the extrema of the conduction and valence bands are at X and Γ (center of the zone), respectively. The LO branches lie above the TO branches in contradiction to predictions. The shell model fit indicates that the charge on the gallium atom is negative. Author (NSA)

N68-33313# National Bureau of Standards, Washington, D. C.
MEASUREMENT AND INTERPRETATION OF CARRIER LIFETIME IN SILICON AND GERMANIUM Final Report, 1 Dec. 1966–1 Jan. 1968
R. L. Mattis, W. E. Phillips, and W. M. Bullis Wright-Patterson AFB, Ohio AF Mater. Lab Jul. 1968 105 p refs
(Contract F33615-67-M-5007)
(NBS-9807; AFML-TR-68-81; AD-671552)

Minority carrier lifetime is a basic parameter for the specification of semiconductor materials for transistors, diodes, and similar devices. Photoconductive decay measurements are routinely made on many crystals used in the fabrication of these devices. Although this measurement suffers both from lack of precision and from limitations in the range of applicability it is the only method for determination of carrier lifetime which has been accepted as standard. This report describes the results obtained during the first year of a continuing research project which was undertaken in order to determine the fundamental limitations on the precision and applicability of this method and to develop alternate methods which might be more suitable under various conditions. Detailed studies of the photoconductive decay method were accompanied by preliminary studies of the photomagnetoelectric method, the diode recovery time method, and the surface photovoltage method and a critical survey of the various methods which have been reported in the literature. The photoconductive decay method was studied in greatest detail. Different forms of the method were investigated, including the use of both pulsed and chopped light, and employing two methods of measurement, one of which was a null method. The effects of many variables such as light intensity, specimen size and temperature were studied. Author (TAB)

N68-33341 National Lending Library for Science and Technology, Boston Spa (England).
MEASUREMENT OF ELECTRON WORK FUNCTIONS FOR CERTAIN ALLOYS
R. B. Tagirov, A. L. Stolov, and S. A. Mashkevich 29 Jul. 1968 3 p refs Transl. into ENGLISH from the Book "Itogi Nauchn. Konf. Kazansk. Univ." Kazan, 1964 p 25–27 In ENGLISH and RUSSIAN *Its* Transl. 68/131
Available from Natl. Lending Library, Boston Spa, Engl.

Photo electric yields of several industrial metals were measured using vacuum and infrared techniques in an attempt to assess the effects of surface layer differences, degree of metal purity, types of heat treatment, and the amount of adsorbed gas on the accuracy of measurements of work functions. Work function determinations were performed on more than 30 alloys with different surface conditions, i.e., after prolonged storage, and after grinding and polishing. The value of the work function in the majority of cases decreased when the surface finish of the metal was improved; however, not as much as the quantum yield value. As a result of cleaning, the quantum yield value markedly increased. Prolonged storage in air resulted in a decrease of work function which was attributed to the appearance of surface oxides. Experiments with a group of molybdenum-base oxidation resistant alloys demonstrated that, under test conditions employed, the work function of different alloys ranged from 3.6 to 4.4 eV depending on the composition and heat treatment. Heat treatment (soaking time and temperature) resulted in either increasing or decreasing the work function. Invariably, when the work function decreased as a result of heat treatment, the photo emission current increased; and conversely, an increase of work function lead to a decrease of the photo current. It was further found that a change in work function by 0.3 to 0.5 eV changed the photo-electric yield by a factor of 4 to 5. The gas layer adsorbed rapidly on the metal surface was preserved under experimental conditions and thus prevented the determination of specific properties of individual metals. S.C.W.

N68-33367# Minnesota Univ., Minneapolis. School of Mineral and Metallurgical Engineering.
SUPERCONDUCTING PROPERTIES OF TRANSITION METAL CARBIDES AND NITRIDES Final Report, 1 Oct. 1965–1 Dec. 1967
Louise E. Toth Feb. 1968 122 p refs
(Contract AF-AFOSR-1012-66)
(AFOSR-68-0265; AD-671944)

Tc, Hc, and Jc measurements were made as a function of alloying composition, deviations from stoichiometry, and crystal structure for several carbides and nitrides. Tcs as high as 17K and upper critical fields of over 136kOe were found for several ternary compositions. Hc2 was found to be limited by the k1 term in the GLAG theory. Thus, the upper critical field depends on the product of the Tc, normal resistivity, and coefficient of electronic specific

heat. Methods other than powder metallurgy were developed for preparing carbides and nitrides. Thin films of nitrides were prepared by reactive sputtering. Critical fields-critical current characteristics were very promising for thin-film solenoid applications. Measurement was made of low temperature heat capacities for molybdenum, niobium, and tantalum carbides as a function of crystal structure and composition, and determination was made of electron-phonon interaction parameters and unrenormalized densities of states. Evaluation of proposed bonding models for carbides and nitrides was made on the basis of low temperature heat capacities measurements. TAB

N68-33388 Oklahoma Univ., Norman.
THE MAGNETIC SUSCEPTIBILITY OF CUPRIC ION IN ZnO
Charles Franklin Dorman (Ph.D. Thesis) 1967 149 p
Available from Univ. Microfilms: HC $7.00/MF $3.00 Order No. 67-16483

From previous analysis of the optical and electron spin resonance spectra of Cu^{2+}:ZnO it was reported that a satisfactory fit with experiment was obtained on reduction of the spin-orbit parameter by a factor of 10 from that of the free ion value (≈ 830 cm^{-1}). As the free ion value for the spin-orbit parameter of Cu^{2+} is large and the crystal field parameter Dq for Cu^{2+}:ZnO is approximately 600 cm^{-1}, the influence of the excited ^2E level on the ground state $^2T_2$ manifold is large owing to connecting elements arising from the spin-orbit interaction energy. A second order Van Vleck transformation was carried out to reduce these intralevel elements by an order of magnitude. The $^2T_2$ manifold was then found to be nearly isolated from the ^2E manifold and second order expressions for the energies for the $^2T_2$ manifold were then obtained. The reported optical and electron spin resonance spectra could then be fit with a value of 200 cm^{-1} for the spin-orbit parameter. Dissert. Abstr.

N68-33434*# Naval Ordnance Test Station, China Lake, Calif. Michelson Lab.
ON THE INTERPRETATION OF COMPLEX LEED PATTERNS
E. Bauer [1968] 29 p refs Presented at 4th Intern. Mater. Symp., Berkeley, Calif., 19–21 Jun. 1968
(NASA ORDER R-05-030-001)
(NASA-CR-96364) CFSTI: HC $3.00/MF $0.65 CSCL 20B

A meaningful structure analysis of crystal surfaces has to make use of the dynamical theory of LEED. For surfaces with complex LEED patterns this leads to extremely extensive and costly numerical calculations. Therefore the number of possible surface models to be examined numerically has to be minimized as much as possible. The procedures used in this selection process are discussed from the point of view of general scattering theory. It is concluded that a three-dimensional approach is more appropriate than the two-dimensional approaches used in the past. The interpretation methods are illustrated in the case of the annealed Si(111) surface with 7×7 and $\sqrt{19}\times\sqrt{19}$ R(23.5°) pattern. Auger electron spectroscopy is used as the major auxiliary tool in selecting surface models compatible with the LEED patterns. Author

N68-33446*# Tyco Labs., Inc., Waltham, Mass.
LEAD TELLURIDE BONDING AND SEGMENTATION STUDY Semiannual Phase Report, Aug. 1, 1967–Jan. 31, 1968
H. Bates, F. Wald, and M. Weinstein 31 Jan. 1968 81 p refs
(Contract NAS5-9149)
(NASA-CR-96293; SAPR-1) CFSTI: HC $3.00/MF $0.65 CSCL 20L

Accurate lattice constant determinations on SnTe in SnTe–metal alloys revealed changes in the original lattice constant of the starting $Sn_{.492}Te_{.508}$ composition, and it is concluded that PbTe–SnTe thermoelectric alloys in contact with metals might change their composition and electrical properties over long periods of time. Investigations of Si – Ge solid solution alloys with several metals revealed two basic types of constitution: one in which equilibria between the Si – Ge and solid solutions of metal silicides and germanides exist, and a second producing a metal silicide in equilibrium with either pure Ge or with the Si – Ge solid solution. Efficiencies of segment Si–Ge–PbTe thermocouples were shown to be approximately 9% at hot junction temperatures of 800°C and above, and power outputs of 2.25 to 2.8 watts per couple. Quantitative metallography showed evidence for fairly extensive migration of pores in pressed-and-sintered $Pb_{.4}Sn_{.6}Te$ thermoelements after operation for 3800 hours in a temperature gradient from 510° to 50°C. Author

N68-33454* Massachusetts Inst. of Tech., Cambridge.
THE RAMAN SPECTRA OF PB–TiO_3 AND SOLID SOLUTIONS OF $NATAO_3$–$KTAO_3$ AND $KTAO_3$–$KNBO_3$
C. H. Perry and N. E. Tornberg [1968] 3 p Paper Presented at Intern. Conf. on Light Scattering Spectra of Solids, N. Y., 3–6 Sep. 1968
(Grants NGR-22-009-237; NSF GP-4923; Contract DA28-043-AMC-02536(E))
(NASA-CR-96362) CFSTI: $3.00 CSCL 20L

The Raman spectra of $PbTiO_3$ and the mixed crystal systems $(Na_x:K_{1-x})TaO_3$ where x = 0, 0.12, 0.40, and 0.85 and $K(Ta_y:Nb_{1-y})O_3$ where y = 0, 0.25, 0.65, 0.89, and 1.0 were studied over the temperature range 10°–800°K. Author

N68-33458 Northwestern Univ., Evanston, Ill.
MAGNETIC ANISOTROPY IN ANTIFERROMAGNETIC CHROMIUM
Ramiro Alfonso Montalvo (Ph.D. Thesis) 1967 117 p
Available from Univ. Microfilms: HC $5.80/MF $3.00 Order No. 67-15296

An anisotropy in the susceptibility of very pure chromium single crystals has been found at temperatures below 312°K, the Neél temperature. This anisotropy was measured as a torque while the crystal was suspended in a uniform magnetic field. The torque has a quadratic field dependence for fields up to 33 kOe indicating the magnetization has a linear dependence on the field. The torque data were taken as a function of magnetic field, 0 to 32 kOe, temperature, 4 to 340°K, crystallographic direction, and sample treatment. The torque, as a function of crystallographic direction was Fourier analysed for a 001 suspension. The analysis yielded a component of a two-fold symmetry below 120°K and components of two-fold and four-fold symmetry above 120°K. Dissert. Abstr.

N68-33460 Purdue Univ., Lafayette, Ind.
STUDY OF ACOUSTOELECTRIC INSTABILITIES AND HOT CARRIER DISTRIBUTION FUNCTIONS BY OPTICAL MODULATION TECHNIQUES
Chander Sen Kumar (Ph.D. Thesis) 1967 173 p
Available from Univ. Microfilms: HC $8.00/MF $3.00 Order No. 67-16668

The present work deals with investigations of nonequilibrium electron and phonon distributions in semiconductors using optical modulation techniques. Propagating domains of ultrasonic flux are spontaneously generated and amplified by pulses of high voltage in p-type GaSb. The primary optical effect observed is a strong decrease in transmission which is restricted to wavelengths at the intrinsic absorption edge. The primary modulation effect is used as a probe for studies of such domain characteristics as width, propagation velocity, and growth pattern. The intervalence band absorption of infrared radiation by hot carriers in p-type Ge is examined. It is found that the absorption is anisotropic, being dependent on the direction of polarization of the light relative to the electric field. The experimental parameters G_0 and G_2 are used to calculate the hot carrier mobility within the framework of the Boltzmann transport equation. Dissert. Abstr.

N68-33508# Joint Publications Research Service, Washington, D. C.
EFFECT OF RADIOACTIVE IRRADIATION ON THE MECHANICAL PROPERTIES OF SOLIDS
V. S. Lenskiy 15 Aug. 1968 42 p Transl. into ENGLISH from Inzh. Sb. (Moscow), v. 28, 1960 p 97–123
(JPRS-46209) CFSTI: HC $3.00/MF $0.65

A literature survey is reported of data noting the effects of radioactivity on the mechanical properties of solid materials, with most of the attention given to the generalization and systemization of practical data to aid the strength engineers in developing calculating methods. The intensity of the neutron beam irradiating given solids and the mechanism of radioactive emission are considered as are the resultant changes of volume and crystal lattice, elastic and plastic properties, and creep. A general method for calculating the effects in irradiated solids is presented that takes into account the various changes that can occur. M.W.R.

N68-33513# AVCO-Everett Research Lab., Everett, Mass.
THEORY OF STABILIZATION OF A SUPERCONDUCTOR INTO THE RESISTIVE STATE
A. El Bindari Jul. 1968 23 p refs
(RR-290)

A theory of the stability of a superconductor carrying a transport current in the resistive mode is presented. The stability is dependent on a parameter θ such that if $\theta > 1$, the superconductor is unstable; if $\theta < 1$, the superconductor is stable. The recovery conditions from the resistive mode to the fully superconducting state are also studied. Under certain conditions when the critical $I_c \propto d^n$, where d is the diameter of the superconductor and $n > 1$, the stability parameter θ is also a function of the dimensions of the superconductor. The influence of a normal metal in good electrical and thermal contact with the superconductor on the stability problem is also included. Author

N68-33521 Polytechnic Inst. of Brooklyn, N. Y.
SOLUTION OF GINZBURG–LANDAU EQUATIONS FOR ARBITRARY TANGENTIAL MAGNETIC FIELDS-EXPERIMENTAL VERIFICATION WITH SUPERCONDUCTING TRANSMISSION LINE
Gerard A. Alphonse (Ph.D. Thesis) 1967 125 p
Available from Univ. Microfilms: HC $6.00/MF $3.00 Order No. 67-13373

The purpose of this dissertation is to determine the dependence of the Ginzburg–Landau (G–L) order parameter on arbitrary tangential magnetic fields, and to experimentally measure it, hence verifying the validity of the theory. In this work the G–L equations are solved for superconductors in the presence of arbitrary tangential fields. It is shown that if the thickness of the specimen is less than the size of Abrikosov's vortices, the equations can be linearized without the usual assumption of zero coupling constant k, and the (reduced) order parameter Φ is magnetic field dependent, but essentially independent of coordinates. For symmetrical fields on films of finite thickness d our solution gives the same results as found by Ginzburg and Landau for $k = 0$: the magnetic transition is second order (i.e., the order parameter goes smoothly to zero) for $d < \sqrt{5}\ \lambda(T,0)$, where $\lambda(T,0)$ is the temperature dependent penetration depth, whereas it is first order (i.e., the order parameter jumps discontinuously to zero) for $< \sqrt{5}\ \lambda(T,0)$. Dissert. Abstr.

N68-33580# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ACTA PHYSICA SINICA, VOLUME 21, NO. 3, 1965 (SELECTED ARTICLES)
26 Sep. 1967 43 p refs Transl. into ENGLISH from Wu Li Hsueh Pao (Peking), v. 21, no. 3, 1965 p 481–502
(FTD-HT-67-159; AD-671740)

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N68-33581# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ELECTRON-PHONON COUPLING IN THE PROBLEM OF IMPURITY ABSORPTION BAND, 1
Yin-yuan Li and Ke-hong Chu *In its* Acta Phys. Sinica, Vol. 21, No. 3, 1965 26 Sep. 1967 p 1–27 refs (See N68-33580 20-26)

For considering the electron–phonon coupling in the problem of an impurity absorption band, a set of normal modes of lattice vibration were formed by the linear combination of plane (running) waves in order to present fully the site symmetry of the impurity. The symmetric (standing) waves of a definite type are characterized by an irreducible representation of the site group. The frequency distribution function of the phonons of a certain symmetry type is that of the lattice vibration divided by a constant. The phonons involved in the transition of an absorption band are restricted to certain symmetry types, but no selection on the frequency may be found. The configuration coordinate approximation of Williams et al was critically examined at this stage. The dependence of the coupling strength on the frequency of phonons was qualitatively discussed, as was the possible importance of the critical points of the frequency distribution. The mathematical analysis of symmetric standing waves was given in detail. The relation between this set of normal modes of lattice vibration and those of an isolated cluster containing a central ion and the ligands was demonstrated. Author

N68-33582# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
THE DIFFUSION OF PHOSPHORUS IN AN OXIDE LAYER ON A SILICON SURFACE
Ko-chen Lee, Shih-ying Hsieh, Chung-te Chu, and Yung Huang *In its* Acta Phys. Sinica, Vol. 21, No. 3, 1965 26 Sep. 1967 p 28–40 refs (See N68-33582 20-26)

The tagged atom technique was used for the investigation of the diffusion of phosphorus ($Na_2Hp^{32}O_4$) in the oxide film on the surface of p-type silicon, the resistivity of which was 5–6 ohm-cm. The 0.5–0.6 μ thick oxide film was grown in water vapor at elevated temperatures. To determine the thickness of the oxide film, a microbalance was used, the sensitivity of which was 10^{5-} g/div. It was found that the growth of oxide film at 1245°C obeys the equation $X^{1.85} = 1.4 \times 10^{-2}t$, where X is the thickness of the oxide film in microns and t is the time in minutes. The results of measurements of the infrared absorption by the oxide film is in agreement with literature values. Diffusion was carried out in quartz ampules filled with air, in the 700–1250°C temperature range over different time intervals, ranging from 4 min. to 5 hrs. The results of this investigation have shown that distribution of phosphorus in the SiO_2 layer is not described by Fick's second law. It may be viewed as consisting of two parts, one of which corresponds to the uniform distribution of concentration, and the second part obeys Fick's second law. Author

27 PROPELLANTS

Includes fuels; igniters; and oxidizers. For basic research see: 06 Chemistry; and 33 Thermodynamics and Combustion. For related information see also: 28 Propulsion Systems.

N68-32601*# Union Carbide Corp., Bound Brook, N. J.
SATURATED HYDROCARBON POLYMERIC BINDER FOR ADVANCED SOLID PROPELLANT AND HYBRID SOLID GRAIN, 1 JANUARY–31 MARCH 1968
James E. Potts, ed. 20 Apr. 1968 31 p Prepared for JPL
(Contracts NAS7-100; JPL-951210)
(NASA-CR-96284) CFSTI: HC $3.00/MF $0.65 CSCL 21H

The continuous stirred autoclave reactor system has been modified by the addition of automated pressure controls. The reactor itself has been replaced by another unit with a higher pressure rating. The new system can operate effectively at 35,000 psi. A melt process employing no solvent and using potassium hydroxide dispersed at 300°C in the polymer melt has been found to give rapid and quantitative elimination of HBr from ethylene/neohexene telomers with a minimum of rearrangement to vinylidene type C=C. Processes using solvents were either not as fast, gave a large amount of rearranged product or both. A new series of telomers has been prepared, this group having ethylene and propylene as comonomers and having $BrCCl_3$, α-bromo isobutyric acid and its *t*-butyl ester as the telogens. A combination of low viscosity and very low penetration temperature make these telomers very attractive as solid propellant binder precursors. Author

N68-32793*# TRW Systems, Cleveland, Ohio.
ANALYTICAL PREDICTIONS OF DELIVERED SPECIFIC IMPULSE
Victor Quan Washington NASA Aug. 1968 137 p refs
(Contract NAS9-4358)
(NASA-CR-1123; TRW-02874-6008-R000) CFSTI: HC $3.00/MF $0.65 CSCL 21I

Summary data are presented on the four computer programs developed to calculate inviscid, one-dimensional and axisymmetric nonequilibrium nozzle flow fields accounting for the nonequilibrium effects of finite rate chemical reactions between gaseous combustion products and velocity and thermal lags between gaseous and condensed combustion products. Written in Fortran 4, these are the (1) one-dimensional reacting gas program, (2) one-dimensional two-phase reacting gas program, (3) axisymmetric reacting gas program, and (4) axisymmetric two-phase perfect gas program. Program limitations are delineated. Tabulated data are included on the results of studies undertaken to determine the chemical species and chemical reactions and reaction rates for typical propellant systems. The implicit integration method used in the programs is described, along with the transonic analyses used to construct the initial lines for the characteristics calculations in the axisymmetric programs. Graphs depicting the results of the four programs are included. M.G.J.

N68-33584*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
A REVIEW OF THE POTENTIAL OF LIQUID-METHANE FUEL FOR SUPERSONIC TRANSPORTS
Richard J. Weber Washington 1968 17 p refs Presented at the Cryog. Eng. Conf., Cleveland, 19–21 Aug. 1968
(NASA-TM-X-52466) CFSTI: HC $3.00/MF $0.65 CSCL 21I

Substitution of liquid methane fuel for conventional kerosene promises reductions in direct operating cost of 30 percent or more. The results are affected by whether airplanes are compared on the basis of fixed payload, by the extent to which limits on engine noise nullify the usefulness of methane's superior cooling capacity, and by the delivered cost of the fuel. The best solution to the problem of fuel evaporation during flight is not yet evident. Author

28 PROPULSION SYSTEMS

Includes air breathing, electric, liquid, solid, and magnetohydrodynamic propulsion. For nuclear propulsion see: 22 Nuclear Engineering. For basic research see: 23 Physics, General; and 33 Thermodynamics and Combustion. For applications see: 31 Space Vehicles. For related information see also: 27 Propellants.

N68-32440*# AiResearch Mfg. Co., Los Angeles, Calif.
INVESTIGATIONS OF MATERIALS TO RESIST HOT CORROSION IN SMALL GAS TURBINE ENGINE RECUPERATORS Quarterly Report, 1 Mar.–31 May 1968
G. Curbishley, O. Jones, and W. Larson 31 May 1968 40 p
(Contract DAAJ02-67-C-0048)
(GAR/LA-HT-67-2512(4); QR-4; AD-671668)

Theoretical and experimental investigations were made of hot corrosion in Type 347 stainless steel and three other candidate materials. The preliminary brazing tests, now complete except for microprobe analysis, consisted of metallographical evaluation of the brazed joints and a 100-hr static hot corrosion test at 1500F. The materials selected for further testing are Hastelloy X, Incoloy 800, Multimet N-155 and CRES 347. The stress rupture hot-corrosion test, in progress, consists of exposing pressurized tubes to a synthetic environment similar to the composition of a gas turbine engine exhaust at three temperature levels to represent the spectrum of recuperator operating conditions. Time to rupture in hours covering failures to date are presented as well as a preliminary failure analysis. The plotted results indicate that all but CRES 347 would be suitable as a recuperator material operating in a 1300 to 1500F temperature. Author (TAB)

N68-32444 National Lending Library for Science and Technology, Boston Spa (England).
EXPERIMENTAL DETERMINATION OF THE PRESSURE OF GASES IN THE PISTON RING SPACE OF A HIGH SPEED DIESEL ENGINE [EKSPERIMENTAL'NOE OPREDELENIE DAVIENIYA GAZOV V ZAKOLECHNOM PROSTRANSTVE BYSTROKHODNOGO DIZELYA]
V. G. Zarenbin et al Mar. 1968 9 p Transl. into ENGLISH from Izv. Vyssh. Ucheb. Zaved., Mashinostro. (Moscow), no. 12, 1966 p 82–86
(RTS-4437) Available from Natl. Lending Library, Boston Spa, Engl.: 12s 6d

The pressure distribution of gases was measured in the cavities of the piston ring seals of the 6Ch 15/18 diesel engine (n = 1500 rpm, N_e = 150 hp). The pressure was measured with strain gage pickups mounted at the level of the second and third piston ring grooves. Experimental relations between the maximum gas pressure in the grooves and the speed, conditions of loading and external operating characteristics of the engine, and other service parameters are presented. Author

N68-32709*# Hughes Research Labs., Malibu, Calif.
ION ENGINE THRUST VECTOR STUDY Quarterly Report
G. R. Brewer, K. Amboss, G. Nudd, H. King, R. Seliger, et al Jul. 1968 153 p refs Prepared for JPL
(Contracts NAS7-100; JPL-952129)
(NASA-CR-96288; QR-2) CFSTI: HC $3.00/MF $0.65 CSCL 21C

To establish the expected degree of thrust vector misalignment in an electron bombardment ion thruster, further results are presented on the change in ion beam current and direction with

electrode displacement. The degree of electrode misalignment due to thermally induced stresses in the accel and screen electrodes is analyzed and shown graphically. A comprehensive analysis of the thrust stand, which will be used to measure the beam deflection, is described. Author

N68-32795*# Mathematical Applications Group, Inc., White Plains, N. Y.

NONLINEAR COMBUSTION INSTABILITY IN LIQUID PROPELLANT ROCKET MOTORS

Samuel Z. Burstein and Wallace Chinitz 30 Jul. 1968 34 p Prepared for JPL

(Contracts NAS7-100; JPL-951946)

(NASA-CR-96280; QR-4) CFSTI: HC $3.00/MF $0.65 CSCL 21B

Nonlinear differential and difference equations are derived to describe the toroidal motor and to treat, in a simple way, a toroidal subsonic-supersonic nozzle. Boundary conditions are stated for use in simulating the boundary values imposed on a gas-injected rocket motor. Results of a test case using these boundary conditions are given. Improvements in the pancake computer program are discussed, and it is reported that the COMB program has the ability to produce instantaneous streakline data graphically. M.G.J.

N68-32906*# General Electric Co., Lynn, Mass. Aircraft Engine Technical Div.

EXPERIMENTAL EVALUATION OF OUTER CASING BLOWING OR BLEEDING OF SINGLE STAGE AXIAL FLOW COMPRESSOR. PART 2: PERFORMANCE OF PLAIN CASING INSERT CONFIGURATION WITH UNDISTORTED INLET FLOW AND BOUNDARY LAYER TRIP

C. C. Koch and L. H. Smith, Jr. 14 Aug. 1968 82 p refs

(Contract NAS3-7618)

(NASA-CR-54588; R68AEG287, Pt. 2) CFSTI: HC $3.00/MF $0.65 CSCL 21E

A 1120 feet per second tip speed rotor having an aspect ratio of 4.5 and an inlet hub-tip radius ratio of 0.5 was tested with undistorted inlet flow and also with a thickened inlet casing boundary layer produced by a trip ring. Overall performance, stall performance and blade element data were obtained. The rotor was designed to produce a total-pressure ratio of 1.47 at a weight flow of 187 lbs/sec and an adiabatic efficiency of 0.905. The peak efficiency attained at design speed was 0.900, occurring at a total-pressure ratio of 1.458 and a weight flow of 181 lbs/sec. Evidence was obtained indicating that rotating stalls initiated in the vicinity of the part-span shroud rather than at the tip. Author

N68-32909*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

OFF-DESIGN THEORETICAL PERFORMANCE OF THREE TURBOFAN ENGINES FOR LIGHT SUBSONIC AIRCRAFT

Gerald A. Kraft and Brent A. Miller Washington 1968 38 p refs

(NASA-TM-X-52469) CFSTI: HC $3.00/MF $0.65 CSCL 21E

Preliminary cycle performance calculations were made for three geared-fan turbofan engines. The three engines presented in this study are the result of some preliminary exploratory studies. In this study, the bypass ratio of 2.5, fan pressure ratio of 1.3, overall compressor ratio of 6.0, and turbine inlet temperature of 1300°F (704°C) were set at the cruise design point of 25,000 feet (7600 meters) and Mach 0.65. The net thrust required was 400 pounds (181 kg) at design and a minimum of 1000 pounds (453 kg) at sea level static. A maximum turbine-inlet temperature of 1500°F (817°C) was allowed at sea level static. With the inlet and nozzle areas held at their design values, the turbine-inlet temperatures often exceeded 1500°F (817°C) and both the outer and inner compressors tended to operate in or near the surge region at full rated speed. The solution consisted of varying the inlet area, primary nozzle area, secondary nozzle area, or some combination of these. Author

N68-32987*# General Motors Corp., Indianapolis, Inc. Allison Div.

EXPERIMENTAL INVESTIGATION OF ADVANCED CONCEPTS TO INCREASE TURBINE BLADE LOADING. 2: PERFORMANCE EVALUATION OF PLAIN ROTOR BLADE

H. G. Lueders Washington NASA Aug. 1968 46 p refs

(Contract NAS3-7902)

(NASA-CR-1172; EDR-4909, V. 2) CFSTI: HC $3.00/MF $0.65 CSCL 21E

The overall performance of a single stage turbine designed with a rotor blade suction surface diffusion factor of 0.3 and negative rotor hub reaction was investigated over a range of equivalent speeds and expansion ratios. Total pressure surveys were made at the stator and rotor exits and a hot-wire survey was taken at the rotor trailing edge. The performance of turbine with this rotor-blade forms a base line that will be compared with advanced turbine blade loading comcepts. Author

N68-33039# Naval Air Test Center, Patuxent River, Md. Flight Test Div.

USE OF THE RATIO OF SPECIFIC HEATS IN THE DETERMINATION OF TURBOJET ENGINE THRUST

William R. Simpson 2 Jul. 1968 16 p refs

(FT-TM-3-68; AD-871898)

The memorandum presents general equations for the calculation of the idealized thrust and thrust correction factor for determination of turbojet engine thrust. Tables of specific heat ratios versus exhaust gas temperature are given. An analysis shows the difference between the use of a constant gamma and a variable gamma. Finally, an explanation of specific heat ratios and a method of choosing an applicable ratio are discussed. Consideration should be given the selection of gamma when the thrust equations are applied. Author (TAB)

N68-33094*# Lamar State Coll. of Technology, Beaumont, Tex. Research Center.

TRANSIENT FLOW ANALYSIS OF REACTION CONTROL SYSTEM FOR APOLLO LUNAR MODULE Final Report

E. P. Martinez Jul. 1968 96 p refs

(Contract NAS9-6666)

(NASA-CR-92232) CFSTI: $3.00 CSCL 21H

A lumped parameter description of the propellant feed system for the L/M-RCS is presented. A simple two-phase model for transient flow analysis of an injector is developed. The injector model couples the feed line description to an existing engine combustor model, providing a system simulation capability. The results of a digital computer simulation are presented for several combinations of system parameters. Qualitative and quantitative agreement with experimental results is within expectations for the scope of the models. Author

N68-33164*# Rocketdyne, Canoga Park, Calif.

SPACECRAFT ROCKET ENGINE CHAMBER INSULATION MATERIALS Interim Report, 1 Jul. 1967-30 Jun. 1968

L. W. Carlson, H. Carpenter, A. L. Huebner, L. Manson, and E. Talmor 30 Jul. 1968 234 p refs

(Contract NAS7-474)

(NASA-CR-96447; R-7548; IR-2) CFSTI: HC $3.00/MF $0.65 CSCL 21H

Three insulation systems were evaluated in an extensive experimental program: multilayers of silica fabric/molybdenum foil, carbon fabric/tantalum foil, and fine tungsten powder dispersed in a matrix of hollow zirconia microspheres. At temperatures

below 2000°F, molybdenum/silica is clearly the superior insulation. Above 2000°F, tantalum/carbon is clearly superior. The tungsten/zirconium insulation system has an order of magnitude higher conductivity than the other material systems at the low temperatures, but is only 30 percent higher at the higher temperature. Means of maintaining tungsten/zirconia homogeneity under vibration have to be provided. Measurements of effective thermal conductivity and thermal stability tests were conducted at temperatures up to and exceeding 3500°F. Author

N68-33215*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
STATE OF THE ART IN SHORT COMBUSTORS
William H. Roudebush Washington 1968 14 p refs Presented at the 6th Congr. of the Intern. Council of the Aeron. Sci., Munich, 9–13 Sep. 1968
(NASA-TM-X-52449) CFSTI: HC $3.00/MF $0.65 CSCL 21E

Increased attention is being given to high temperature combustors for advanced aircraft engine applications. Severe durability problems are likely to be encountered. Using substantially shorter combustors can help in this respect since there is less surface to cool and better structural strength. It has been difficult in the past to make improvements in this direction without hurting efficiency and exit temperature profile. The high temperature combustors, however, may provide an environment in which the penalties in performance associated with the shorter designs are not so severe. To examine this possibility NASA has undertaken a program on very short annular combustors for high temperature aircraft engines. Some of the results of that program are described in this paper. Author

N68-33321*# Boeing Co., Seattle, Wash. Aerospace Group.
POLYMERIC POSITIVE EXPULSION BLADDERS FOR LIQUID OXYGEN SYSTEMS Final Report
John T. Hoggatt Jun. 1968 146 p refs
(Contract NAS3-7952)
(NASA-CR-72418) CFSTI: HC $3.00/MF $0.65 CSCL 21H

This report covers the evaluation of eighteen polymeric expulsion bladders for the containment of liquid oxygen. The bladders, 10 of Mylar film and 8 of Kapton film construction, were evaluated for expulsion capability and endurance, and response to dynamic loading conditions in a liquid oxygen environment. Ten of the bladders were subjected to expulsion cycling with 25 complete cycles as the endurance goal. The remaining eight bladders experienced slosh, vibration, impact, and burst type loadings to study their structural integrity and LOX compatibility. Author

N68-33330*# General Motors Corp., Indianapolis, Ind. Allison Div.
SINGLE-STAGE EXPERIMENTAL EVALUATION OF BOUNDARY LAYER BLOWING TECHNIQUES FOR HIGH LIFT STATOR BLADES. 2: DATA AND PERFORMANCE OF FLOW GENERATION ROTOR AND SINGLE-SLOTTED 0.75 HUB DIFFUSION FACTOR STATOR
M. L. Miller and T. E. Beck Feb. 1968 192 p refs
(Contract NAS3-7619)
(NASA-CR-54565; EDR-5691) CFSTI: $3.00 CSCL 21A

This program seeks to establish experimentally the extent to which it is feasible to increase compressor stator loading and stall-free flow margin by employing suction surface boundary layer blowing techniques. A secondary objective was to obtain blade element data for design use. The test was conducted in three phases: (1) blade element and overall performance data were obtained from a state-of-the-art single-stage flow generation rotor with inlet guide vanes; (2) mid-span suction surface static pressure data were obtained with a row of 0.75 diffusion factor unslotted stator vanes for evaluation of boundary layer separation which could be used for selection of slot locations; and (3) a row of 0.75 diffusion factor single-slotted stators with self-energized blowing boundary layer control was tested. The resulting data are presented in graphs and tables. Author

N68-33331*# Rocket Research Corp., Seattle, Wash.
DEVELOPMENT OF THE SUBLIMING SOLID CONTROL ROCKET, PHASE 3 Final Report, 25 Apr. 1966–24 Jul. 1967
24 Jul. 1967 74 p refs
(Contract NAS5-10201)
(NASA-CR-95620) CFSTI: HC $3.00/MF $0.65 CSCL 21H

Efforts are described to uprate the performance of the Subliming Solid Control Rocket (SSCR) by supplying thermal energy to the propellant in order to improve the thrust duty cycle and the thrust control. The principal areas investigated were: (1) use of waste heat of a Radioisotope Thermoelectric Generator (RTG) to sublime the propellant; (2) heating an SSCR with a radioisotope capsule, using a cylindrical heat pipe; and (3) using a thermal switch heat pipe for temperature control of an SSCR heated by a continuous heat source, such as a radioisotope or RTG. Three propellant valves were evaluated. The testing of several thermal switch heat pipe configurations for operation in the temperature range from 150° F to 350° F demonstrated the effectiveness of the inert gas reservoir concept as a means of temperature control. K.W.

N68-33338 National Lending Library for Science and Technology, Boston Spa (England).
THE CONSTRUCTION OF MAIN CASTINGS FOR THE JET ENGINES OF SUPERSONIC AIRCRAFT IN HEAT-RESISTING STEELS AND ALLOYS [LA REALISATION DES CARTERS PRINCIPAUX EN ACIERS ET ALLIAGES REFRACTAIRES POUR TURBOREACTEURS D'AVIONS SUPERSONIQUES]
Robert Brunetaud and Pierre Lescop 4 Dec. 1967 7 p Transl. into ENGLISH of a paper presented at Les Aciers Specieux Au Service De L'Aviation, Paris, 1 Jun. 1967 In ENGLISH and FRENCH /*ts* Transl. 67/213
Available from Natl. Lending Library, Boston Spa, Engl.

Presented is an evaluation of (1) industrial grades of heat resisting austenitic steels and alloys used in the construction of main casings of supersonic aircraft jet engines; and (2) fabrication problems associated with the use of these materials. The following four classes of materials are evaluated: iron-rich alloys; nickel-base alloys which are hardened by adding niobium, aluminium, and titanium, the nickel-base alloys which are hardened by the addition of aluminium and titanium; and the cobalt-base alloys. In the discussion of fabrication problems, particular attention is paid to problems encountered during the construction of large casings for the OLYMPUS 593 B using WASPALOY. Fabrication problems evaluated include those arising during (1) the production of semi-finished products and forging; (2) forming; (3) welding; (4) heat treatment; and (5) machining. The impact of metallurgical and industrial processing limitations on casing design trends is briefly discussed. S.C.W.

N68-33418*# Chrysler Corp., New Orleans, La. Engineering Dept.
FINAL FLIGHT PERFORMANCE PREDICTION FOR SATURN AS-206 (MISSION 276) PROPULSION SYSTEM S-IB-6 STAGE
G. W. Koser 15 Jun. 1968 40 p refs
(Contract NAS8-4016)
(NASA-CR-96473; TR-P&VE-68-68) CFSTI: HC $3.00/MF $0.65 CSCL 21H

The prediction data were determined by simulating the first stage powered flight of the Saturn AS-206 with the Mark IV computation procedure. Analyses of the prediction data indicate

that inboard and outboard engine cutoffs will occur approximately 137.91 seconds and 140.91 seconds after first motion, respectively. These times are based on defined LOX and fuel load specific weights and stage propellant fill weights for the revised launch schedule for AS-206. Author

N68-33436# Solar, San Diego, Calif.
DEVELOPMENT OF AN AMMONIA-BURNING GAS TURBINE ENGINE Final Technical Report, 30 Sep 1964–31 Jul. 1966
M. G. Bull Apr. 1968 57 p refs
(Contract DA-44-009-AMC-824(T))
(ER-1584-3; AD-671667)

Combustion rig testing with ammonia fuel was conducted using a single can burner configuration. Ammonia was injected into the burner in the liquid state, a combination of vapor and liquid, and in the vapor state. Vaporized ammonia injection gave the most encouraging preliminary results; consequently systems using liquid ammonia injection were abandoned early in the program. Ammonia vapor combustor tests showed it was possible to burn ammonia in a manner similar to that used in conventional hydrocarbon burning combustors, but with a significant reduction in range of flammability. Improvements in combustion performance were obtained by the use of catalytic aids, and techniques using catalytic oxidation of ammonia showed the greatest potential. Two different ammonia combustion systems were developed for use with a gas turbine engine in the 250 hp size range. One system was essentially similar to a conventional hydrocarbon, single can combustor, but of increased size. The second system incorporated an oxidizing catalyst bed integral with the combustor as a means of increasing fuel reaction rate and reducing combustor volume. A standard hydrocarbon burning engine was modified to enable operation using both types of ammonia combustion systems in addition to its normal hydrocarbon system. A development test program was conducted to obtain satisfactory engine operation with each type of combustion system. Performance measurements were made with the engine operating with each type of combustion system. Performance measurements were made with the engine operating with each type of combustion system. The results are plotted and allow comparison between ammonia fuel and hydrocarbon fuel engine performance. Author (TAB)

N68-33472# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
SCALE FORMATION IN TURBOJET ENGINES [NAGAROOBRAZOVANIYE V VOZDUSHNO-READTIVNYKH DVIGATELYAKH]
N. I. Marinchenko, Ya. B. Chertkov, and V. A. Piskunov 29 Aug. 1967 9 p refs Transl. into ENGLISH from Khim. i Tekhnol. Topliv i Masel (Moscow), no. 1, 1964 p 51–55
(FTD-HT-23-825-67; AD-671650)

Scale formation in jet engines was studied and the particular purpose of the present work is a study of some of these problems. It was concluded that scaling in turbojet combustion chambers is formed in zones having inadequate temperature (250-400C) and too low oxygen concentration for adequate combustion. The scale was found to consist of multistage, consecutive, deep-destruction products of the organic molecule with considerable enrichment of carbon in the final product. The deposit also consisted of oxidizable hydrocarbons and nonhydrocarbon organic compounds with sulfur, oxygen and nitrogen contents. At temperatures of 200-400C in an oxygen environment, oxidizing processes transform nonhydrocarbon compounds into resins and ultimately into scale. Author (TAB)

N68-33575# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
JOURNAL OF MECHANICAL ENGINEERING
14 Jul. 1967 78 p refs Transl. into ENGLISH from Chi Hsieh Kung Ch'eng Hsueh Pao (Peking), v. 13, no. 4, 1965 p 1–42
(FTD-HT-23-958-67; AD-669427)

CONTENTS:

1. HEAT TRANSFER IN TURBOJET COMBUSTION CHAMBERS AND EXPERIMENTATION OF FILM COOLING EFFECTS C.-t. Tu, K.-t. Yin, and N.-k. Chen p 1–31 refs (See N68-33576 20-33)

2. EXPERIMENTATION ON AIR-COOLED GAS TURBINE ROTORS Y.-l. Ko and C.-c. Lu p 32–76 refs (See N68-33577 20-28)

N68-33577# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
EXPERIMENTATION ON AIR-COOLED GAS TURBINE ROTORS
Yung-lo Ko and Chien-ch'eng Lu *In its* J. of Mech. Eng. 14 Jul. 1968 p 32–76 refs Presented at the 1st Nationwide Eng. Thermophys. Technol. Conf., Aug. 1965 (See N68-33575 20-28)

Summarized are results of an investigation of air cooling of gas turbine rotors, including: methods of theoretical calculation of temperature field and electrothermal analog methods, analytical investigation of cooling, experiments on turbine blade heating, etc. In this article, the main content of gas turbine cooling problems is first critically investigated, then theoretical and analog solutions of temperature fields are separately shown for various high-temperature turbine components in steady operating conditions. Further, the above methods are used to make an analytical comparison of various kinds of turbine cooling. Finally, results of experimental investigation on heat emission of turbine cascades are presented. Author

N68-33585*# National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.
VARIABLE GEOMETRY REQUIREMENTS IN INLETS AND EXHAUST NOZZLES FOR HIGH MACH NUMBER APPLICATIONS
Milton A. Beheim and Aaron S. Boksenbom Washington 1968 28 p refs Presented at the 6th Congr. of the Intern. Council of the Aeron. Sci., Munich, 9–13 Sep. 1968
(NASA-TM-X-52447) CFSTI: HC $3.00/MF $0.65 CSCL 21H

As part of an overall study on air breathing propulsion, problems relating to variable geometry requirements in inlets and exhaust nozzles for high Mach number applications are being studied. Emphasis is on studying these components as part of a complete propulsion system rather than on the aerodynamic characteristics of the isolated components. Podded engine concepts are emphasized that permit, to some extent, the minimization of the range of geometric variables; and a nacelle has been mounted near the aft lower surface of the wing to shield the inlet from adverse angle of attack effects. Proper shaping of the nacelle and adjacent wing surfaces can minimize total aircraft drag by generating favorable interference effects. Mach number range for the study is 2.5 to 3.0, and high performance at both supersonic and subsonic speeds is a goal. Engine cycle characteristics for both turbofan and turbojet engines were assumed and initial testing was on axisymmetric configurations. M.W.R.

N68-33586*# Chrysler Corp., New Orleans, La. Space Div.
FINAL FLIGHT PERFORMANCE PREDICTION FOR SATURN AS-207 (MISSION 276) PROPULSION SYSTEM S-1B-7 STAGE
J. P. Elfers 15 Jun. 1968 39 p refs
(Contract NAS8-4016)
(NASA-CR-96451; TR-P&VE-68-69) CFSTI: HC $3.00/MF $0.65 CSCL 21H

The prediction data were determined by simulating the first stage powered flight of the Saturn AS-207 with the Mark IV

computation procedure. Analyses of the prediction data indicate that inboard and outboard engine cutoffs will occur approximately 136.94 seconds and 139.94 seconds after first motion, respectively. These times are based on defined LOX and fuel load specific weights and stage propellant fill weights for the revised launch schedule for AS-207. Author

29 SPACE RADIATION

Includes cosmic radiation; solar flares; solar radiation; and Van Allen radiation belts. For related information see also: 13 Geophysics; and 24 Physics, Atomic, Molecular, and Nuclear.

N68-32364# New Hampshire Univ., Durham. Dept. of Physics.
STUDY OF THE INTENSITY TIME VARIATIONS OF THE COSMIC RADIATION Final Report, 1 Nov. 1962–31 Oct. 1967
John A. Lockwood May 1968 229 p refs
(Contract AF 19(628)-2352)
(AFCRL-68-0277; AD-671553)

The data-recording systems for the cosmic-ray neutron monitors at Durham and Mt. Washington were completely automated and neutron multiplicity systems added. The barometric pressure coefficients for both monitors were reevaluated. New differential response and specific yield functions were deduced for neutron monitors at sea level and mountain elevations with vertical cutoff rigidities in the interval 0.7 less than P sub c less than 10 Gv. From the variation in the intensity recorded by neutron monitors from 1958 to 1965, the solar modulation has been found to be described exp(-K/P) for 0.5 less than P less than 50 Gv. An investigation was made of the solar flare associated cosmic-ray increase on Jan. 28, 1967, as recorded by the neutron monitors. The properties of three different types of boron-loaded liquid scintillators were investigated as possible detectors for measuring the neutron leakage flux from the earths atmosphere. Measurements of the neutron intensities above the atmosphere at rocket altitudes with a moderated He3 neutron detector were completed. Author (TAB)

N68-32398 Rice Univ., Houston, Tex.
ANGULAR MOMENTUM EFFECTS OF SOLAR AND STELLAR WINDS
Jerry Lee Modisette (Ph.D. Thesis) 1967 80 p
Available from Univ. Microfilms: HC $4.20/MF $3.00 Order No. 67-13109

The solar wind stretches the solar magnetic fields out to large distances, and the rotation of the sun twists the field into a spiral. This spiral field exerts a torque on the sun, and couples the rotation of the sun to the interplanetary medium. The angular momentum loss of the sun is determined by the solution of the equation of conservation of angular momentum for the solar wind to be that calculated by assuming rigid-body rotation of the corona out to the point at which the radial velocity is equal to the radial Alfvén velocity. However, it is also shown that the angular momentum lost from the sun is divided between the solar wind particles and the interplanetary magnetic field, with the distribution depending upon the details of the radial velocity variation with radial distance. Using radial velocity profiles based on an isothermal corona, and on a model assuming rapid acceleration of the solar wind near the sun, the torque and the radial profile of angular velocity are calculated for a range of field magnitudes, solar wind velocities, and solar wind densities. The torque can produce an exponential decay of the solar rotation with a time constant close to the main-sequence lifetime of the sun. Dissert. Abstr.

N68-32458 National Lending Library for Science and Technology, Boston Spa (England).
THE RELATIONSHIP BETWEEN PROTON FLARES AND THE CORONA IN THE 11-YEAR CYCLE
M. N. Gnevyshev and L. Krivsky [1968] 11 p refs Transl. into ENGLISH from Astron. Zh. (Moscow), v. 43, no. 2, 1966 p 385–389
(M-7130) Available from Natl. Lending Library, Boston Spa, Engl.

It is shown that the numbers of proton flares and of chromospheric flares have two maxima in the 11-year cycle, as have the intensity of the corona, the number of prominences, the area covered by sun spots and the intensity of solar radio emission. Proton flares occur in regions of enhanced coronal brightness. The second maximum is characterised by a predominant appearance of especially intense phenomena, such as cosmic flares. A catalogue of proton flares for 1954–1964 is given. Author

N68-32908*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
SOLAR PROTONS (135 TO 1650 KeV) AFTER THE FLARE OF JULY 7, 1966 OBSERVED IN THE MAGNETOTAIL AND MAGNETOSHEATH
Andrei Konradi Aug. 1968 23 p refs
(NASA-TM-X-63316; X-612-68-321) CFSTI: HC $3.00/MF $0.65 CSCL 03B

Protons with energies E>135 KeV were observed in the tail of the magnetosphere following the flare of July 7, 1966. These protons have an isotropic pitch angle distribution. The maximum intensity of the protons reached $\approx 1.2 \times 10^4$ (cm^2 sec ster)$^{-1}$ for particles with P>15 MV between 1000 and 1100 UT and 1400 and 1500 UT July 8, 1966. The energy spectrum of the protons expressed as an exponential in momentum indicates a monotonic softening; the characteristic rigidity, Po, changing from about 50 to 10 MV. An hour long excursion of the satellite into the magnetosheath during the peak of the proton flux showed that the proton intensity is lower in the magnetosheath than in the magnetosphere by a factor of two. The observed pitch angle distribution is flat in both regions. Author

N68-32930 National Lending Library for Science and Technology, Boston Spa (England).
AN INVESTIGATION OF MOTIONS IN FLARES RELATIVE TO THE TRANSVERSE MAGNETIC FIELD COMPONENT [ISSLEDOVANIE DVIZHENII VO VSPYSHKAKH OTNOSITEL'NO POPERECHNOI SOSTAVLYAYUSHCHEI MAGNITNOGO POLYA]
M. B. Ogir' Nov. 1967 13 p refs Transl. into ENGLISH from Izv. Krymsk. Astrofiz. Observ. (Moscow), v. 36, 1967 p 69–75
(RTS-4240) Available from Natl. Lending Library, Boston Spa, Engl.: 17s 6d

We consider the character of the motion in four chromospheric flares, recorded on a coronograph at the Crimean astrophysical observatory in light of the H_α line, relative to the transverse magnetic field direction. The field was recorded on the magnetograph of the solar tower telescope at the observatory in the photospheric iron line λ 5250Å. Author

N68-33033# Illinois Univ., Urbana. Dept. of Ceramic Engineering.
DEFECT STRUCTURE FERROELECTRICS (DIELECTRIC AND STRUCTURAL INVESTIGATIONS OF FERROELECTRICS POSSESSING DEFECT STRUCTURES) Final Report, Sep. 1961–Sep. 1968
Victor J. Tennery and Kenneth W. Hang 15 Jul. 1968 38 p refs
(Contract Nonr-1834(39))
(AD-671905)

Thermal and X-ray diffraction studies of the system Na(x)K(1-x)NbO3 have revealed the presence of phase boundaries at approximately 82.5, 67.5 and 52.5 mole percent NaNbO3 at 25 degrees C in addition to the one previously reported very near the NaNbO3 end member. The optimum piezoelectric properties observed in this system are apparently associated with compositions near the latter boundary. Calorimetric determinations of the enthalpy and entropy changes associated with the ferroelectric-ferroelectric and ferroelectric-paraelectric transformations in the system clearly revealed the presence of the phase boundaries. No multiple cell perovskite structures were observed in the system at NaNbO3 concentrations below about 70 mole percent. Solid solution was observed in the system Na(1-x)Sr(N)Cd(P)NbO3 where N+P=x/2 between 0=or<x=or<0.40 when the ratio of N:P was within the limits 1:2 to 2:1. A ferroelectric pseudomonoclinic perovskite phase was observed at 25 degrees C when 0=or<x-or<0.10 in the series studied. Author (TAB)

N68-33082*# California Univ., Berkeley. Space Sciences Lab.
SOLAR WIND DISTURBANCES ASSOCIATED WITH FLARES
John M. Wilcox 6 May 1968 32 p refs Presented at COSPAR Symp. on Solar Flares and Space Res., Tokyo, 10 May 1968 *Its* Ser. 9, Issue 24
(Grants NsG-243; NGR-05-003-230; Contract Nonr-3656(26); Grant NSF GA-1319)
(NASA-CR-96315; AD-669925) CFSTI: HC $3.00/MF $0.65 CSCL 03B

The structure of the quiet solar wind and interplanetary magnetic field is reviewed to provide background and perspective for the discussion of solar wind disturbances associated with flares. Corotating structures with a recurrence period of about 27 days must be distinguished from structures directly produced by flares. Flare-induced discontinuities have been interpreted as low Mach number shock waves; in one such event (which appears to be fairly typical) the solar wind velocity increased from 340 to 385 km/sec, the density increased from 9 to 23 protons/cc, and the average temperature increased from 30,000 to 80,000 degrees K. In another event the interplanetary magnetic field strength increased from 12.2 to 20.8 x 10 to the -5th power gauss, and the rms deviation of the orthagonal components of the field approximately doubled. Many interplanetary shock waves appear to be decelerated as they expand and propagate through the solar wind plasma. The most reasonable interpretation appears to be in terms of an intermediate strength shock wave with an energy input in the range of 10 to the 30th power to 10 to the 32nd power ergs. Author (TAB)

N68-33161*# Douglas Aircraft Co., Inc., Santa Monica, Calif. Missile and Space Systems Div.
A LOW-ENERGY SOLAR COSMIC RAY EXPERIMENT FOR OGO-F
M. H. Wolpert, P. R. Satterblom, D. W. Burtis, and A. J. Masley Feb. 1968 11 p Presented at the 14th Nucl. Sci. Symp., Los Angeles, 31 Oct.-2 Nov. 1967
(Contract NAS5-9324)
(NASA-CR-96312; Douglas Paper-4906) CFSTI: HC $3.00/MF $0.65 CSCL 22A

The OGO-F low-energy solar cosmic ray experiment measures the differential energy spectrum of protons (5 MeV to 80 MeV) and alphas (18 MeV to 160 MeV) using two double-diffused, totally depleted silicon diodes. The pulse amplitude discrimination system, the data multiplexing scheme, and the in-flight calibrator are discussed. Author

N68-33196*# Volt Technical Corp., Washington, D. C.
ON THE NATURE OF STEADY SHORT-PERIOD OSCILLATIONS OF THE EARTH'S MAGNETIC FIELD (PC3 AND PC4)
Yu. A. Kopytenko and O. M. Raspopov 1 Sep. 1968 9 p refs Transl. into ENGLISH from Kosmich. Issled. (Moscow), v. 6, no. 4, 1968 p 617-623
(Contract NAS5-12487)
(NASA-CR-96386; ST-GM-PF-10750) CFSTI: HC $3.00/MF $0.65 CSCL 04A

The possibility is shown of explaining the generation mechanism of type-Pc3 and Pc4 geomagnetic pulsations by resonance of magnetohydrodynamic waves and the tubes of force, adjacent to radiation belt maximum. The possibility is considered of interpreting the experimental data with the help of the proposed model. Author

N68-33223# Pennsylvania State Univ., University Park. Dept. of Astronomy.
SOLAR RADIO FLUX OBSERVED AT UNIVERSITY PARK, PENNSYLVANIA, JULY–AUGUST–SEPTEMBER 1967
John P. Hagen Aug. 1968 40 p
(GRANT NSF GA-720)
(SR-014)

Report contains solar radio flux data recorded at 10700 Mc/s, 2700 Mc/s and 960 Mc/s during the quarter 1 July 1967 to 30 September 1967. A table of distinct events is also given. Author

N68-33370*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
EXPERIMENTAL TESTS OF THE SUPERNOVAE ORIGIN OF COSMIC RAYS
C. E. Fichtel and H. B. Ogelman Washington Sep. 1968 21 p refs
(NASA-TN-D-4732) CFSTI: HC $3.00/MF $0.65 CSCL 03B

The general problem of supernovae explosions as a possible origin of cosmic rays is reviewed. The shock wave theory of Colgate et al., the only detailed model of supernovae explosions to date, predicts a short, intense high energy gamma-ray pulse associated with the explosion and cosmic ray acceleration. Two experimental tests capable of detecting the predicted initial explosion are suggested. One is a spark-chamber gamma-ray telescope which, when flown above the earth's atmosphere, could detect pulses of protons above 30 mev. The other experiment, which is ground-based, could detect the fluorescence produced in the atmosphere by the electromagnetic pulse radiated by the supernova during its explosion. Author

N68-33381 Arizona Univ., Tucson.
THE ANTINUCLEON COMPONENT OF THE PRIMARY COSMIC RAY FLUX
James Robert Wayland, Jr. (Ph.D. Thesis) 1967 50 p
Available from Univ. Microfilms: HC $3.00/MF $3.00 Order No. 67-16509

We have solved a Fokker–Planck diffusion equation for the diffusion and acceleration of cosmic rays. A time-independent solution is obtained by assuming that the contributions to the present intensity of particles injected at a uniform rate during all past times is equivalent to summing the intensities over all future time of particles injected at a given time. We have used continuous deceleration and fluctuations in acceleration to explain the energy spectrum. This gives a general expression for a power law spectrum in which the exponent varies as $\gamma = 0.09\ h\ (E/m) + 0.9$ thus allowing a very good fit to the experimental energy spectrum. We then apply a previously developed expression for the production of antiprotons to obtain an injection spectrum. This and the above solutions are then applied to three extreme cases of possible origin. The resulting antiproton spectrum depends upon whether the material encountered by the primary cosmic ray protons is mostly inside or outside the regions of acceleration. Dissert. Abstr.

N68-33417*# State Univ. of Iowa, Iowa City. Dept. of Physics and Astronomy.
UNIVERSAL COSMIC RAYS AND HARRISON'S INHOMOGENEITY POSTULATE
Peter D. Noerdlinger Aug. 1968 5 p refs
(Grant NGL-16-001-002)
(NASA-CR-96472; Rept.-68-41) CFSTI: HC $3.00/MF $0.65 CSCL 03B

Cosmologies of the type suggested by Harrison, in which initial baryon inhomogeneity leads to the formation of galaxies, are shown to preclude the possibility that cosmic rays are universal. Author

N68-33477 Princeton Univ., N. J.
TRANSFER OF LYMAN-α IN DIFFUSE NEBULAE
Lawrence Herman Auer (Ph.D. Thesis) 1967 65 p
Available from Univ. Microfilms: HC $3.60/MF $3.00 Order No. 67-13478

The Monte Carlo method is applied to the solution of the equation of transfer for Lα radiation in nebulae with optical thicknesses up to 10^5. Plane parallel geometry, two-level atoms, and constant temperature are assumed. The correlation between the direction of scattering and the frequency redistribution is taken into account exactly. A method is developed for accelerating the solution by treating the line core analytically and using the Monte Carlo only in the wings. It is found that for doppler broadening the assumption of complete redistribution is a reasonably satisfactory approximation. For lines with finite natural width, the presence of Lorentz-wings, where scattering tends to be coherent, reduces the mean number of scatterings from the case with zero natural width. This effect is seen only after the optical depth at line center has become great enough that the nebula is opaque at all frequencies in the core. The emergent flux has a double-humped frequency distribution. Dissert. Abstr.

N68-33503*# Volt Technical Corp., Washington, D. C.
ON THE LONGITUDINAL ELECTRIC FIELD IN THE MAGNETOSPHERE AT QUASI-MAXWELLIAN DISTRIBUTION OF CHARGED PARTICLES
M. V. Samokhin 31 Aug. 1967 8 p refs Transl. into ENGLISH from Kosmich. Issled., (Moscow), v. 6, no. 4, 1968 p 604–610
(Contract NAS5-12487)
(ST-PF-GM-10752) CFSTI: $3.00 CSCL 04A

The distribution of the longitudinal electric field and the density of charged particles are investigated in a one-dimensional symmetrical magnetic mirror for a given potential difference between the magnetic equator and a certain plane, behind which total absorption of charged particles takes place. It is assumed that the charged particles whose mirror points are located between the equator and the absorption plane, have a Maxwellian distribution by velocities, while particles with mirror points situated outside that region, are absent (such a distribution by velocities is called quasi-Maxwellian). Discussed here is the formation mechanism of the soft component in the outer trapped radiation belt, which is linked with the escape of charged particles of low energy into the polar atmosphere under the action of a longitudinal electric field in combination with the azimuthal particle drift in a nonuniform magnetic field, and in the presence of directed motion of matter in the Earth's magnetosphere. Author

N68-33564 Arbeitsgemeinschaft Fuer Forschung Des Landes Nordrhein-Westfalen (West Germany).
NON-THERMAL COSMIC RADIATION SOURCES [NICHTTHERMISCHE KOSMISCHE STRAHLUNGSQUELLEN]
Michael Grewing, Joerg Pfleiderer, and Wolfgang Priester 1968 52 p refs In GERMAN; ENGLISH and FRENCH Summary *Its* Ser. No. 91

The emphasis of this paper is on quasi-steller sources (quasars). After a report on their discovery a detailed discussion is given of the characteristic properties of both, the optical and the radio emission of these objects. Also the problem of synchrotron self-absorption in the low frequency range is discussed. Furthermore, the variability of the optical as well as the high frequency radio emission is treated. Finally the different theories that have been suggested to explain the large emission- and absorption-line red shifts of quasars are outlined in detail. As it becomes more and more evident that a connection might exist between quasi-steller radio sources and radio galaxies two chapers on supernovae-remnants and radio galaxies have been included. All three classes of objects are characterized by a large amount of non-thermal radiation which is usually interpreted as magneto-bremsstrahlung (synchrotron emission) of relativistic electrons. This leads to the presently most challenging problem of astrophysics: how large amounts of high-energy particles can continuously be produced. In an appendix the theory of magneto-bremsstrahlung of relativistic electrons is outlined, including a chapter on synchrotron self-absorption. Author

30 SPACE SCIENCES

Includes astronomy and astrophysics; cosmology; lunar and planetary flight and exploration; and theoretical analysis of orbit and trajectory. For related information see also: 11 Facilities, Research and Support; and 31 Space Vehicles.

N68-32270 National Lending Library for Science and Technology, Boston Spa (England).
THE CALIBRATION OF MEASUREMENTS MADE WITH A MAGNETOGRAPH [K VOPROSU O KALIBROVKE IZMERENII MAGNITOGRAFA]
D. N. Pachkovsky Nov. 1967 6 p refs Transl. into ENGLISH from Izv. Krymsk. Astrofiz. Observ. (Moscow), v. 36, 1967 p 51–55
(RTS-4238) Available from Natl. Lending Library, Boston Spa, Engl.: 12s 6d

Stokes' parameter of radiation was measured within the profile of a selected spectral line by a magnetograph, and the effective region of frequencies was determined by the magnitude and position of the magnetograph slits relative to the center of the line. All of the measurements made on the magnetograph were expressed in units of a signal, resulting from the Doppler line shift at the edge of the sun, that is equivalent to the signal from the purely longitudinal field of the sort of absolute magnitude giving rise to line splitting. Calibration curves from the magnetograph measurements take into account only the true line absorption, line scattering, and thin layer line formation. The magnetograph apparatus itself had little influence on the transverse field signal but significantly changed the longitudinal field. On the other hand, calibration curves computed on the assumption of a thin and an optically thick layer line formation differ significantly for the transverse field signal and practically coincide for the longitudinal field signal. M.W.R.

N68-32271 National Lending Library for Science and Technology, Boston Spa (England).
CALIBRATION OF THE RECORDS OF SOLAR MAGNETOGRAPH
A. B. Severny Oct. 1967 52 p refs Transl. into ENGLISH from Izv. Krymsk. Astrofiz. Observ. (Moscow), v. 36, 1967 p 22–50
(RTS-4236) Available from Natl. Lending Library, Boston Spa, Engl.: £2

Because methods usually employed for the calibration of longitudinal and transverse magnetic field signals recorded by solar magnetographs exhibit calibration dependence and require many theoretical assumptions, various alternatives were investigated. Calibration was made on the basis of magnetograph recording comparisons with measurements of longitudinal field signals carried out at a field observatory, but these field measurements did not give any information on the transverse lines. Calibration was, therefore, carried out by means of visual measurements of the Zeeman splitting; and the resulting comparison of signals was in good agreement. Reasons for the deviation between theoretical and empirical calibration curves were analyzed. M.W.R.

N68-32285# Grumman Aircraft Engineering Corp., Bethpage, N. Y. Research Dept.

A REVIEW OF THE ENVIRONMENTS OF MERCURY, VENUS, AND MARS

K. M. Foreman, E. Nowatzki, F. R. Pomilla, J. Reichman, J. H. Scanlon et al Jul. 1968 245 p refs

(RM-420)

A compilation is presented of established facts and plausible speculation concerning the environments of these planets. Typical data are the composition, topography, and temperature of the planetary surface as well as temperature and pressure profiles, compositional models of the atmosphere, and planetary magnetic fields. External phenomena such as the solar wind, interplanetary magnetic fields, and cosmic rays which may affect all of these planets are given. The report is presented in a modified handbook form with the data organized into tables and figures. Bibliographies are included for each separate subject. K.W.

N68-32302 National Lending Library for Science and Technology, Boston Spa (England).

INVESTIGATION OF METALLIC EMISSION LINES IN WHISKERS ON THE SOLAR DISC [IZUCHENIE EMISSII LINII METALLOV V USAKH NA DISKE]

A. N. Koval Dec. 1967 26 p refs Transl. into ENGLISH from Izv. Krymsk. Astrofiz. Observ. (Moscow), v. 37, 1967 p 62–81

(RTS-4244) Available from Natl. Lending Library, Boston Spa, Engl.: 40s

Photometric emission profiles of whiskers in metallic and hydrogen lines were obtained and the mechanism of line broadening was investigated. The Doppler distribution of the emission in whiskers agrees satisfactorily with observations. The ratio $\Delta\lambda_D/\lambda$ and the derived turbulent velocities are different for hydrogen and the metals and indicate a velocity increase with height. Author

N68-32310 National Lending Library for Science and Technology, Boston Spa (England).

ON OPTICAL THICKNESS OF DUST NEBULA [OB OPTICHESKIKH TOLSHCHINAKH PYLEVYKH TUMANNOSTEI]

A. K. Karasev Feb. 1968 9 p refs Transl. into ENGLISH from Uch. Zap. Leningr. Gos. Univ., Ser. Mat. Nauk (Leningrad), v. 41, no. 334, 1967 p 14–20

(RTS-4380) Available from Natl. Lending Library, Boston Spa, Engl.: 17s 6d

A value is obtained for the emergent light flux from a homogeneous spherical dust nebula with a star in its center. The ratio of the nebula brightness to star brightness (D) is computed. The theoretical values of D are compared to the observed values, and some conclusions on the value of the optical thickness of the dust nebula are drawn. C.T.C.

N68-32323# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

FIRST RECORDS IN SPACE

I. G. Borisenko 25 Aug. 1967 95 p Transl. into ENGLISH of the book "Pervyye Rekordy V Kosmose" Moscow, Izd. Mashinostr., 1965 p 1–88

(FTD-MT-66-139; AD-671652)

A popular propaganda narrative account of world records established by Soviet astronauts. The author, sports commissar of the Central Aero Club, was closely connected with all flights in order to present official data to the International Aviation Federation to insure that these achievements would be recognized as world records. In narrative and tabulated form he reports dates, times, place of launch, weight of space craft, duration of flight, distance, altitude, number of orbits, and precise location of the landing of the craft and of the astronauts. In contrast to the first six flights, that of Vostok-2 is lacking in detail. The only record claimed is for altitude. Weight of the craft is listed as about 6000 kg. Distance travelled is reported as more than 720,000 kms. Time and place of landing is omitted. Author merely states that he talked to the two astronauts a little more than 24 hours after launch when they had already landed on Permian Earth. Contrary to his earlier narrative he makes no mention that he recorded the markings on the side of the craft after landing. The final portion of the book is devoted to the U.S. space flights all of which are compared unfavorably to those of USSR. Attention is focused on each American mishap in contrast to no mention whatsoever of any Soviet deviation from plan or of any difficulty encountered. Author (TAB)

N68-32368 National Lending Library for Science and Technology, Boston Spa (England).

THE FORMATION OF ABSORPTION LINES IN A MAGNETIC FIELD [OBRAZOVANIE LINII POGLOSHOHENIYA V MAGNITNOM POLE]

D. N. Rachkovskii Dec. 1967 23 p refs Transl. into ENGLISH from Izv. Krymsk. Astrofiz. Observ. (Moscow), v. 36, 1967 p 9–21

(RTS-4317) Available from Natl. Lending Library, Boston Spa, Engl.: £1 12s 6d

The technique of representing the scattering matrix in the form of two factors is generalized to the case of a line with an arbitrary type of splitting the levels. Consideration is given to the formation of a line in a semi-infinite atmosphere with a uniform magnetic field and a constant ratio (with optical depth) of the absorption coefficient in the line to the absorption coefficient in the continuous spectrum. The theory is also generalized to the case of a line with anomalous Zeeman splitting. M.G.J.

N68-32377# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

THEORY OF TRAFFIC CONTROL FOR SPACE VEHICLES

V. M. Ponomarev 21 Dec. 1967 65 p Transl. into ENGLISH from Teoriya Upravleniya Dvizheniem Kosmich. Apparatov (Moscow), 1965 p 177–230, 299–318

(FTD-MT-24-369-67; AD-671958)

Contents: Program of control during a maneuver; Peculiarities of control during a maneuver; Pulse programs of control during a maneuver in the plane of orbit; Pulse control programs during a space maneuver; Program of control during a maneuver with low thrust; Program of control during a landing on the moon; Peculiarities of control during a landing on the moon; Programs of control during a landing from a holding orbit; and Programs of control during vertical landing. TAB

N68-32389# Osservatorio Astronomico di Roma (Italy).

SOLAR MAGNETIC FIELDS Final Scientific Report, 1 Feb. 1968–31 Jan. 1968

Massimo Cimino 10 Feb. 1968 24 p refs

(Contract AF 61(052)-912)

(AFCRL-68-0326; AD-671487)

Attention is called to the instrumental improvements (Babcock-type magnetograph, chromospheric patrol etc.) and the development of some new techniques, as the atomic beam spectroscopy in absorption. The editorial effort of the observatory is demonstrated by the publication of the Monthly Bulletin Solar Phenomena and the new international Photographic Journal of the Sun. Author (TAB)

N68-32416*# Applied Physics Lab., Johns Hopkins Univ., Silver Spring, Md.
ROLL RESONANCE FOR A GRAVITY-GRADIENT SATELLITE
J. M. Whisnant and D. K. Anand Apr. 1968 19 p refs Sponsored in part by NASA
(Contract NOw-62-0604-c)
(NASA-CR-96236; TG-986; AD-669995) CFSTI: HC $3.00/MF $0.65 CSCL 22A

Previous studies of gravity-gradient satellite attitude stabilization showed that large roll angles could occur for a partially shadowed orbit. The cause was determined to be a resonance effect due to solar radiation pressure. An expression for the solar torque for roll on a dumbbell-shaped satellite is presented herein. The amplitude of the torque is shown to be a function of the angle between the satellite-sun line and the normal to the orbit plane. For circular orbits, an expression is derived to determine for what position of the sun relative to the orbit plane the resonance effect is a maximum. For orbits of modest eccentricity, the amount of orbit shadowed as a function of sum-orbit orientation is determined. The persistence of the resonance effect for retrograde orbits is discussed. Author (TAB)

N68-32450# Auroral Observatory, Tromso (Norway).
REPORT OF THE JOINT SATELLITE STUDIES GROUP. ANNUAL MEETING OSLO, APRIL 1968 Final Report
1 Apr. 1968 305 p refs
(Contract F61052-67-c-0088)
(USS6-3; AFCRL-68-0260; AD-670223)

The report is a collection of a number of papers written by members of the joint satellite studies group. The bulk of the papers are concerned with total ionospheric electron content and satellite scintillation. A number of papers describe new equipment that has been developed by the members. Author (TAB)

N68-32514# Applied Physics Lab., Johns Hopkins Univ., Silver Spring, Md.
NUTATIONAL DAMPING OF A SLOWLY SPINNING SATELLITE STABILIZED BY USE OF A ROTOR
D. K. Anand, P. P. Pardoe, and J. M. Whisnant Apr. 1968 43 p refs
(Contract NOW-62-0604)
(APL-TG-997; AD-671801)

The nutational damping of a slowly spinning satellite, stabilized with a small rotor, is analyzed. The characteristic equation for the case of damper motion in a plane passing through the spin axis is seen to be similar to that of damper motion in a plane perpendicular to the spin axis. A parametric study of the characteristic equation is made for the case of one and two dampers. The damping characteristics of the one damper, with counterweight, appears to be preferable. Author (TAB)

N68-32604*# TRW Systems Group, Redondo Beach, Calif.
MARS SURFACE GAS DIFFUSION STUDY Final Progress Report
F. W. Thomas 27 May 1968 41 p refs Prepared for JPL
(Contracts NAS7-100; JPL-951981)
(NASA-CR-96286; TRW-09514-6008-R000) CFSTI: HC $3.00/MF $0.65 CSCL 22A

The soft landing of a spacecraft on the surface of Mars will result in a flow of heat and exhaust gases into the soil. The results of an analytical study on these transport phenomena are presented in this final report. General governing equations for heat and mass transport in a porous medium are established. The equations are then reduced to forms which best describe the flow of heat and exhaust gases into the Mars soil and for which closed form solutions can be obtained. Approximate boundary conditions selected with regards to the rate of descent and engine cut-off height of the spacecraft are utilized to obtain specific solutions. A value of the thermal diffusivity is used which best accounts for the soil type, gas pressure and temperature expected on the Mars surface. Multicomponent diffusion theory can not be applied to the diffusion processes encountered here, and an effective binary diffusion coefficient is therefore used in the equations governing exhaust gas diffusion into and out of the soil. Adsorption and subsequent desorption of exhaust gases by the Mars soil may occur. However, the lack of data on adsorption and desorption rates precludes a concise analysis of these effects. Author

N68-32627 National Lending Library for Science and Technology, Boston Spa (England).
INTERFEROMETRIC INVESTIGATION OF THE RED AND GREEN CORONA LINES DURING THE ECLIPSE ON 30th MAY 1965
A. B. Delone and E. A. Maskarova Feb. 1968 3 p ref Transl. into ENGLISH of the Periodical "Astronomicheskii Tsirkulyar, Byuro Astronomicheskikh Soobshchenii" Moscow, Akad. Nauk SSSR, no. 435, 7 Aug. 1967 p 1-3
(RTS-4354) Available from Natl. Lending Library, Boston Spa, Engl.: 7s 6d

Simultaneous photographs of red and green coronal lines were made by the Fabry-Perot etalon interferometer during the total eclipse of May 30, 1965, through clearances between clouds. To determine the instrumental contour and to check the adjustment of the etalon, krypton lamp photographs were taken before and after the eclipse. Approximately two-thirds of the measured contours of the red coronal lines could not be represented by Doppler contours, although in 8 of the 150 cases the observed non-Doppler contours could be presented as the sum of two Doppler contours. Most of the measured red coronal lines, corrected with instrumental halfwidth, were between 0.9 and 1.3A. Halfwidths of both the red and green lines give temperatures above the ionization temperature for the Fe XIV ion. M.W.R.

N68-32631*# National Aeronautics and Space Administration, Washington, D. C.
LUNAR SURFACE STUDIES Continuing Bibliography With Indexes
Jun. 1968 115 p refs
(NASA-SP-7003(04)) CFSTI: HC $3.00/MF $0.65 CSCL 22A

Subject coverage concentrates on theory of lunar origin, the lunar atmosphere, and the physical characteristics of the lunar surface, such as topography, geology, and stratigraphy. References are also included to techniques of lunar observation, measurement, and analysis, e.g., photography, photometry, and spectrophotometry, as well as references to the instrumentation and equipment used in lunar investigations. Author

N68-32653 National Lending Library for Science and Technology, Boston Spa (England).
SOME PECULIARITIES OF THE MOTIONS IN SINGLE SUNSPOTS, COMMUNICATION 1 [O NEKOTORYKH OSOBENNOSTYAKH DVIZHENII V ODINOCHNYKH SOLNECHNYKH, PYATNAKH 1]
S. N. Gopasyuk Nov. 1967 15 p refs Transl. into ENGLISH from Izv. Krymsk. Astrofiz. Obser. (Moscow), v. 35, 1966 p 139–149
(RTS-4112) Available from Natl. Lending Library, Boston Spa, Engl.: £1 7s 6d

Photoelectric observations of radial velocities and longitudinal magnetic fields in two large single sunspots are assessed in an attempt to answer the following questions relating to sunspot velocity field peculiarities (i.e., the Evershed effect): (1) Where on the solar disc is the spot situated when the sign of the Evershed velocities is reversed? (2) What are the velocity components at that point? Observations were carried out in three spectral lines in succession, viz. λ5220 (Lande factor g = 3.0), λ5288.55 (g ≈ 1.0), and λ5123.7 (g = 0). A theory is proposed for explaining the main characteristics of the Evershed effect which is based on the assumption that the magnetic field floats upwards during the entire life of the spot. The applicability of the proposed theory to explain the Evershed effect in the photosphere and in the chromosphere is discussed. S.C.W.

N68-32654 National Lending Library for Science and Technology, Boston Spa (England).
TEMPORAL VARIATIONS OF THE MAGNETIC FIELD IN ACTIVE SOLAR REGIONS [VREMENNYE IZMENENIYA MAGNITNOGO POLYA V AKTIVNYKH OBLASTYAKH NA SOLNTSE]
S. I. Gopasyuk Dec. 1967 27 p refs Transl. into ENGLISH from Izv. Krymsk. Astrofiz. Observ. (Moscow), v. 36, 1967 p 56–68
(RTS-4239) Available from Natl. Lending Library, Boston Spa, Engl.: 40s

Preliminary results from photoelectric recordings of the longitudinal magnetic field and of radial velocities during the appearance, development, and disappearance of spots in active solar regions are analyzed in an attempt to explain the phenomena which result in the strengthening and the disappearance of the field on the surface of the Sun. S.C.W.

N68-32681*# Techtran Corp., Glen Burnie, Md.
EQUIPMENT OF THE AUTOMATIC STATION "LUNA-10" FOR THE INVESTIGATION OF THE γ-RADIATION OF LUNAR ROCK
B. G. Yegiazarov and B. N. Kononov Washington NASA Aug. 1968 11 p refs Transl. into ENGLISH from Kosmich. Issled. (USSR), v. 6, no. 2, Mar.–Apr. 1968 p 265–272
(Contract NASw-1695)
(NASA-TT-F-11895) CFSTI: HC $3.00/MF $0.65 CSCL 22B

The scintillation γ-spectrometer installed aboard the automatic station Luna-10 is described. In order to exclude the background of charged particles in the spectrometer sensors, a stratified phosphor, the crystal NaI(Tl) 38 mm long by 28 mm in diameter was used in a container made of scintillating plastic. The amplitude the instrument is given. Author

N68-32688 National Lending Library for Science and Technology, Boston Spa (England).
RESEARCH ON THE GLOBULAR CLUSTER M13 [ISSLEDOVANIE SHAROVOGO SKOPLENIA M13]
Z. I. Kadla Jan. 1968 87 p refs Transl. into ENGLISH from Izv. Glavnoi Astron. Observ. (Pulkovo), v. 24, no. 5, 181, 1966 p 93–123
(RTS-4134) Available from Natl. Lending Library, Boston Spa, Engl.: 40s

Details are given on the methods used to determine the proper motions and magnitudes not only of the stars belonging to the globular cluster M13, but also of those belonging to the background (80′×80′). Plates giving the U, B, and V magnitudes were used to obtain magnitudes and color indexes for the majority of the 923 stars with measured proper motions. For calibration, use was made of the photoelectric standards and of the U, B, and V magnitudes of six bright stars in the background. The B and V magnitudes obtained for stars in a 10′ × 10′ region with its center at the center of M13 were compared with previously obtained data. Results show that their possible external errors do not exceed ±0^{m}03. Author

N68-32720*# Smithsonian Astrophysical Observatory, Cambridge, Mass.
DISCRETE LEVELS OF METEOR BEGINNING HEIGHT
Zdenek Ceplecha 7 Jun. 1968 60 p refs
(Contract NSR-09-015-033)
(NASA-CR-96295; SAO Special Rept.-279) CFSTI: HC $3.00/MF $0.65 CSCL 03B

Discrete levels of meteor beginning height are studied in detail, mainly by means of $h_B - v_\infty$ plots. A summary of the observational evidence is presented. Among the interpretations of these discrete levels, composition and fragmentation seen to be the most important. Author

N68-32744*# Westinghouse Electric Corp., Baltimore, Md.
DIGITAL PROGRAM FOR DYNAMICS OF NON-RIGID GRAVITY GRADIENT SATELLITES
James L. Farrel, James K. Newton, and James J. Connelly Washington Aug. 1968 99 p
(Contract NAS5-9753-10)
(NASA-CR-1119) CFSTI: HC $3.00/MF $0.65 CSCL 22A

A digital program has been written to determine the dynamic behavior of discretized models for gravity gradient satellite structures. Both passive (elastic reaction, damping) and active (controller) internal torques can be included in the computational model. The program can be utilized simply by observing straight-forward directions given in the introductory section of this report, and a concrete example (hinged assembly model of the Radio Astronomy Explorer satellite) of program adaptation is described in detail. To facilitate application to other configurations a clear separation is made between 1) computations applicable to a general gravity gradient satellite, and 2) specific RAE computations. Author

N68-32794 National Lending Library for Science and Technology, Boston Spa (England).
THE VELOCITY FIELD IN AN ACTIVE REGION AT SPOT APPEARANCE STAGE [POLE SKOROSTEI V AKTIVNOI OBLASTI NA STADII POYAVLENII PYATEN]
S. I. Gopasyuk Dec. 1967 22 p refs Transl. into ENGLISH from Izv. Krymsk. Astrofiz. Observ. (Moscow), no. 37, 1967 p 29–43
(RTS-4242) Available from Natl. Lending Library, Boston Spa, Engl.: 37s 6d

Data are presented on the change in velocity fields in the active region beginning from the moment of sun spot appearance. Photoelectric recordings of the radial velocities along with the magnetic fields were made on October 31, and November 1 and 3, 1964. The analyses indicate (1) A comparison of charts of the velocity field with charts of the longitudinal magnetic field shows that the most significant changes in velocities occur in regions of strong fluctuation of weak longitudinal magnetic fields. (2) The velocities of gas inflow are greatest inside the region occupied by sunspot. (3) During the appearance of the sunspot, the velocity field in the active region at the chromosphere level is completely

different from that observed for a developed group of sunspots. (4) The highest velocities of gas descent correspond with places where there were strong magnetic fields. Gas ascent was observed only in places where there were weak longitudinal magnetic fields. (5) At the stage of sunspot origination, the velocity field in the active region is substantially different from that observed for developed groups of sunspots, where the velocity field changes rapidly with time. M.G.J.

N68-32801# Naval Research Labs., Washington, D. C.
MEASUREMENTS OF THE SOLAR BRIGHTNESS DISTRIBUTION AT 14.50 GHZ Final Report
James P. Hollinger Jun. 1968 20 p refs
(NRL-6892; AD-671788)

Observations of the solar brightness distribution at 14.50 GHz have been made using the NRL 85-ft reflector. The apparent angular size, intensity, and relative position of the active regions present on the solar disk were measured on six different days. These measurements were used to compute the radio brightness centroid relative to the geometrical center of the solar disk and the flux and size of the active regions. Spectral corrections were applied to the data to derive the brightness centroid at 15.375 GHz. Author (TAB)

N68-32802# ITT Federal Labs., San Fernando, Calif.
RESEARCH ON INFRARED CELESTIAL BACKGROUNDS Final Report, Oct. 1966–Oct. 1967
Stephen D. Price Dec. 1967 48 p refs
(Contract AF 19(628)-5040)
(AFCRL-68-0041; AD-671526)

The study of the infrared celestial background was conducted at the Mt. John University Observatory of the South Island, New Zealand, from October 1966 through October 1967. The instrument used for the survey of the sky at 2.2 microns from -30 degrees to the South Celestial Pole is a 24-inch, f/2 cast aluminum parabolic mirror, Kanigen-nickel coated, polished to one wave (1/4 wave in the infrared), and aluminized. The data gathered in the survey indicate that the southern sky is rich in objects bright in the infrared. In particular, a 2 x 4 minute of arc diffuse source was discovered in the direction of a dark nebula in the Milky Way. Author (TAB)

N68-32803# Boeing Scientific Research Labs., Seattle, Wash. Information Sciences Lab.
A COMPUTATIONAL PROCEDURE FOR FIXED-TIME FUEL-OPTIMAL CONTROL OF LINEAR STATE-CONSTRAINED SYSTEMS
A. Frederick Fath May 1968 34 p refs
(D1-82-0723; Rept.-19; AD-671428)

A procedure is given for the computation of the fuel-optimal control for linear state-constrained systems where convex polygonal (possibly time-varying) sets are used for specifying the allowable control vectors, and the allowable state vectors. The terminal condition can be imposed through a convex target set or through exact specification of the terminal state. The solution is obtained by formulating the problem so that the techniques of linear programming with upper bounds can be used. The use of these techniques and the special structure of the reformulated problem results in a computationally efficient algorithm. As an example, the algorithm is used for the solution of a space rendezvous problem. Author (TAB)

N68-32806 Princeton Univ., N. J.
K LINE PHOTOMETRY OF A STARS
Richard Conn Henry (Ph.D. Thesis) 1967 128 p
Available from Univ. Microfilms: HC $6.20/MF $3.00 Order No. 67-13495

A narrow-band photoelectric grating slot spectrometer, compensated for seeing and transparency variations, has been constructed. Observations of the strength of the calcium K line have been obtained for 146 A stars using this spectrometer, and the telescope facilities of Kitt Peak National Observatory. It is found that if Am stars are excluded, which is possible using four-color and Hβ photometry, the K line measure permits a reddening-independent estimate of the b-y color with an rms error of 0^{m}01. For normal stars, the deviation of a star from the mean relation found between the K line strength and b-y color is found to be well correlated with Stromgren's metallicity indicator, $\Delta[m_1]$. Am stars are found to have generally very weak K lines, as expected, but a suprising number have normal strengths. This agrees with an example and suggestion of Preston. Dissert. Abstr.

N68-32903*# Volt Technical Corp., Washington, D. C.
PHOTODISSOCIATION OF C_2 MOLECULES IN COMET ATMOSPHERE
D. O. Mokhnach Greenbelt, Md. NASA. Goddard Space Flight Center 27 Aug. 1968 7 p refs Transl. into ENGLISH from Dokl. Akad. Nauk SSSR. Ser. Astron. (USSR), v. 180, no. 4, Jun. 1968 p 817–820
(Contract NAS5-12487)
(NASA-CR-96291, ST-CDM-OA-10740) CFSTI: HC $3.00/MF $0.65 CSCL 03B

The photodissociation of C_2 molecules in the atmosphere of comets is discussed starting from the most probable initial velocity v_0 of molecules C_2 and CN, the lifetime τ and the effective dissociation cross-section σ_d of the molecule C_2. The result obtained by the present author is considered as preliminary, but it is hoped that it can be further refined if the forthcoming comet photometry is performed at least as carefully as was done by Miller for the 1959K Bernham comet in 1968. Author

N68-32904*# Volt Technical Corp., Washington, D. C.
ON THE EMERGENCE MECHANISM OF LUNAR MARIA
A. L. Sukhanov Greenbelt, Md. NASA. Goddard Space Flight Center 26 Aug. 1968 7 p refs Transl. into ENGLISH from Dokl. Akad. Nauk SSSR, Ser. Astron. (USSR), v. 181, no. 2, 1968 p 309–312
(Contract NAS5-12487)
(NASA-CR-96292; ST-LPS-LS-10744) CFSTI: HC $3.00/MF $0.65 CSCL 03A

Various hypotheses are discussed with reference to possible mechanisms having created lunar maria. Several peculiarities of lava distribution rule out the "diffluence" mechanism from a central basin, i. e., lavas flooding maria and cirque floors can hardly originate from a unique center. On the other hand, it seems that the feeding channels are scattered about the entire area of a forming recession with thickening along its rims, these channels originating from a single source of which limit variants are discussed. The notion of a continuous, rather shallow fusion layer is introduced, suggesting the principle of connecting vessels. Comparison is made with conditions on Earth, where no such analogy can exist. Author

N68-32928 National Lending Library for Science and Technology, Boston Spa (England).
AN INVESTIGATION OF THE MAGNETIC FIELD AND GAS VELOCITY IN SUNSPOTS AT DIFFERENT LEVELS WITH THE MAGNETOGRAPH. 1: AN INVESTIGATION OF THE EVERSHED EFFECT IN A COMPLEX SPOT GROUP ISSLEDOVANIE MAGNITNOGO POLYA I SKOROSTI GAZA V SOLNECHNYKH PYATNAKH NA RAZNYKH GLUBINAKH

S POMOSHCHYU MAGNITOGRAFA. 1: ISSLEDOVANIE EFFEKTA EVERSHEDA V SLOZHNOI GRUPPE PYATEN]
R. N. Ikhsanov Oct. 1967 17 p refs Transl. into ENGLISH from Izv. Krymsk. Astrofiz. Observ. (Moscow), v. 37, 1967 p 44–55
(RTS-4243) Available from Natl. Lending Library, Boston Spa, Engl.: £1 10s

The Evershed velocities in the large complex group of spots observed in September 1963 have been studied. Three lines of different intensity were used for the determination of the radial velocities, thus permitting the investigation of motions of matter in the spots at various depths. It is found that the Evershed velocity varies with depth and the velocity gradient with depth depending on the size of the umbra (spot) as well as the value of the Evershed Effect. The relation between the maximal radial velocity and the position of the umbra (spot) on the solar disc also indicates that there is a velocity gradient with depth in a spot. This relation differs for velocities determined from lines of various intensities; a lower line intensity corresponds to a steeper decrease with approach to the limb. Author

N68-32929 National Lending Library for Science and Technology, Boston Spa (England).
MAGNETIC FIELDS OF SMALL SUNSPOTS AND PORES [MAGNITNYE POLYA MELKIKH SOLNECHNYKH PYATEN I POR]
N. V. Steshenko Nov. 1967 12 p refs Transl. into ENGLISH from Izv. Krymsk. Astrofiz. Observ. (Moscow), v. 37, 1967 p 21–28
(RTS-4241) Available from Natl. Lending Library, Boston Spa, Engl.: £1

Spectrograms of 20 pores with diameters from 1 to 6 inches obtained at conditions of high quality solar images (resolution higher than 1") were used for the measurements of the magnetic fields of pores. It is found that the magnetic field strength of the smaller pores (1".5–2") is 1400 gauss on the average and that of the larger pores $\geq$ 1500 gauss. Not one of the observed pores has a field strength less than 1000 gauss. Spectrograms obtained during days with good quality solar images show that the field strength of small sunspots with diameters within the limits 6 to 12 inches is greater by 200 to 300 gauss than the mean field strength of the smallest pores. Visual observations of magnetic fields indicate the presence of field strengths up to 1000 gauss, and sometimes higher, in places without spots. On the basis of these data it is concluded that the minimal field strength on spots or pores is about 1000–2000 gauss. The magnetic field of a pore is an extremely compact formation. The field gradient along the Solar surface at the umbra photosphere boundary is $\geq$ 4 gs/km for pores with a diameter of $\approx$ 5". Author

N68-32942# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.
THE EFFECTS OF TIDAL FRICTION ON THE EVOLUTION OF THE MARTIAN MOON, PHOBOS
William Poehlman, Jr. (M.S. Thesis) Jun. 1968 163 p refs
(GA/MECH/68-4; AD-671998)

The equations of motion, perturbed by tidal forces, are derived based on the mathematical model used by G. J. F. MacDonald (corrected to include the higher order zonal harmonics of the potential function). These equations are averaged by the Fourier analysis and integrated by the 4th Order Runge-Kutta method to obtain the past history and future evolution of the orbital parameters of Phobos, Deimos, the Moon and Triton. It was found that Phobos evolved to its present state from a nearly synchronous orbit (a = 5.9 Martian radii) having an inclination of about 1.7 deg. to the Martian equator. It was also determined that the future lifetime of Phobos is limited to about 47 million years. The evolutions of Deimos, the Moon and Triton are included for comparison purposes. Author (TAB)

N68-32978*# National Aeronautics and Space Administration, Langley Research Center, Langley Station, Va.
THEORY AND RESULTS ON COLLECTIVE AND COLLISIONAL EFFECTS FOR A ONE-DIMENSIONAL SELF-GRAVITATING SYSTEM
Frank Hohl Washington Aug. 1968 80 p refs
(NASA-TR-R-289) CFSTI: HC $3.00/MF $0.65 CSCL 03B

The equilibrium properties of one-dimensional self-gravitating systems are investigated analytically. One-dimensional models are used to perform computer experiments tracing the evolution of stellar systems. The stationary solution of the Vlasov equation for a one-dimensional system of stars as computed for an interesting class of initial conditions is found to correspond to a minimum-energy configuration. The results of the numerical experiments are compared with theory. For initial energies far from the minimum equilibrium energy the system becomes unstable and breaks up into smaller clusters. A variational principle was applied to the one-dimensional stellar system to show that stationary distribution functions which decrease monotonically in going outward from the center of the system are stable. The one-dimensional model is of interest as an approximation to the distribution of velocity and mass normal to the galactic plane of a greatly flattened galactic system. Observational results for the gravitational force normal to the galactic plane of the Galaxy agree with the results obtained from the one-dimensional model. Thermalization effects for systems containing small numbers of stars were investigated. The fluctuation of the kinetic energy was found to be inversely proportional to the square root of the number of particles in the system. Author

N68-33023# Boeing Scientific Research Labs., Seattle, Wash.
A NEW THERMOPHYSICAL MODEL OF THE LUNAR SOIL
D. F. Winter and J. M. Saari Jun. 1968 17 p refs
(DI-82-0729)

A particulate thermophysical model of the lunar soil is described which utilizes the results of laboratory experiments with evacuated powders. Excellent agreement is achieved with data acquired at far infrared and millimeter wavelengths. The parameters of the model are consistent with soil properties deduced from Surveyor spacecraft experiments. With minor modifications, the model may be useful in current efforts to interpret passive radiation from Mercury. Author

N68-33055*# National Aeronautics and Space Administration, Ames Research Center, Moffett Field, Calif.
A METHOD FOR COMPUTING LUMINOUS EFFICIENCIES FROM METEOR DATA
Barrett S. Baldwin, Jr. and H. Julian Allen Washington Sep. 1968 70 p refs
(NASA-TN-D-4808) CFSTI: HC $3.00/MF $0.65 CSCL 22A

The details of a model for the ablation of a stone meteoroid passing through the atmosphere are presented. The model allows for a decrease in mean density due to frothing, which results from the intense heating at low atmospheric pressures. The present results are a refinement of a previously published analysis since new information on the properties of meteoritic materials has been utilized. A method was also found for taking into account a delay, in light production resulting from the time required to vaporize chunks of froth in the meteor wake. The introduction of a frothing ablation model in an analysis of super-Schmidt meteor data allows an interpretation in terms of originally solid meteoroids for meteors previously thought to have been produced by fragile low-density meteoroids. At the same time, the computed luminous efficiency factor, τ_{op}, is found to vary substantially with velocity. Above 35 km/sec the value of τ_{op} is close to that recommended by Verniani. As the velocity is reduced below 25 km/sec τ_{op} increases to a level about six times greater. Author

N68-33070# Cornell Univ., Ithaca, N. Y. Center for Radiophysics and Space Research.
PROBING THE MAGNETOSPHERE AND THE SUBIONOSPHERE AT HIGH RADIO FREQUENCIES Final Report, Dec. 1965–May 1968
Gian-Carlo Rumi May 1968 156 p refs
(Grant NSF GP-5452)
(CRSR-302)

Theoretical considerations and experimental data are presented in this report on Project LIMBO (Luxembourg Interaction Magnetosphere Backscattering Observation), designed to investigate HF radio wave guidance along the geomagnetic lines of forces and to probe the region below the earth's ionosphere using radio wave interaction. Development and operation of a radar for this purpose on 13.866 MHz at Ithaca, N.Y., is described. Special efforts were made to measure the polar diagram of a 16-yagi antenna array by recording a CW signal from the transmitter and antenna aboard a KC 135 aircraft during overflight. The resulting data are arranged and discussed in terms of long-range lunar, magnetospheric, and "round-the-world" echoes, nonlinear effects in the D region as detected by cross modulation techniques, and columnar resonances affecting meteor echoes according to the Herlofson theory. K.W.

N68-33091*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
EFFECT OF MISSION MODE AND ORBIT ECCENTRICITY ON UNMANNED OUTER PLANET CAPTURE MISSIONS
Susan M. Norman [1968] 4 p refs Presented at the AIAA/AAS Astrodyn. Specialists Conf., Grand Teton Natl. Park, Wyo., 3–5 Sep. 1968
(NASA-TM-X-61142) CFSTI: HC$3.00/MF$0.65 CSCL 22C

The performance advantages of employing elliptic capture orbits for unmanned missions to Jupiter, Saturn, Uranus, and Neptune are investigated. As part of this investigation, the relative merits of the direct flight mode and the Jupiter swingby mode of heliocentric transfers are compared. A method of presentation is shown that permits the effects of trip time, capture orbit eccentricity, and transfer mode to be evaluated. It is shown that, depending on the weight to be placed in planetary orbit, definite trip time–orbit eccentricity regions exist within which either transfer mode is superior. Author

N68-33101# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
DETERMINING THE PROBABILISTIC OF THE PARAMETERS OF PERTURBED MOTION OF AN ARTIFICIAL EARTH SATELLITE [OPREDELENIYE VEROYATNOSTNYKH KHARAKTERISTIK PARAMETROV VOZMUSHCHENNOGO DVIZHENIYA ISKUSSTVENNOGO SPUTNIKA ZEMLI]
I. V. Ignatov 20 Jul. 1967 15 p refs Transl. into ENGLISH from Prikl. Mekh. (USSR), v. 1, no. 12, 1965 p 82–86
(FTD-HT-23-871-67; AD-671735)

The problem of approximate determination of the probabilistic characteristics (mathematical expectation and variance) of parameters of an osculating elliptical orbit is analyzed for an artificial satellite in a central gravitational field, taking the resistance of the atmosphere as the only perturbing force. Equations of motion of such a satellite in osculating elements are written from which approximate expressions for increments of parameters at an arbitrary revolution of the orbit are derived. Author (TAB)

N68-33131*# Aztec School of Languages, Inc., Acton, Mass.
A GENERAL METHOD OF ORBIT DETERMINATION [LOESUNGSVORSCHLAG ZUM BAHNBESTIMMUNGSPROBLEM]
M. Schneider Washington NASA Sep. 1968 18 p refs Transl. into ENGLISH from Rept. BMwF-FB-W-67-35
(Contract NASw-1682)
(NASA-TT-F-11908) CFSTI: $3.00 CSCL 22C

The problem of orbit determination is considered as a boundary value problem. The equivalent integral equation is solved by Hammerstein's method of an infinite number of variables. The proposed method of orbit determination solves the combined problem of preliminary and definitive orbit determination. Author

N68-33169*# National Aeronautics and Space Administration, Washington, D. C.
AEROSPACE ELECTRONIC SYSTEMS TECHNOLOGY
1967 319 p refs Briefing for Ind. Held at MIT, 3–4 May 1967 Sponsored by the Electron. Ind. Assoc.
(NASA-SP-154) GPO: HC$1.25; CFSTI: MF$0.65 CSCL 22A

Conference papers are presented on NASA planning and requirements for electronic systems technology, with particular reference to mission goals; earth orbital, lunar, and planetary technologies; and avionics. For individual titles see N68-33168 through N68-33189.

N68-33170*# National Aeronautics and Space Administration, Washington, D. C.
MANNED SPACE UTILIZATION AND EXPLORATION
Maurice J. Raffensperger *In its* Aerospace Electron. Systems Technol. 1967 p 3–16 (See N68-33169 20-30)

The general acceptance of a manned space station concept is discussed from the viewpoint of its importance in attaining long-duration crew operations and spacecraft performance experience essential to deep space flights or prolonged lunar base activity. Earth-orbital activities planning is detailed, and the space station concepts being considered for the Apollo Applications Program (AAP) are described. The value of orienting a broad program of research toward specific user goals and laying out systematic programs for achieving them is stressed, as the manned earth-orbital program will be based on an interlacing of selected experiments designed to support 13 scientific and technical areas. Plans for planetary exploration are examined in terms of the mass requirements and opportunities in earth orbit from 1970 through 1990 for manned Mars missions, the general arrangement within the flyby mission spacecraft for a crew of four, and the systems elements for manned Mars landing. The scientific goals established for the lunar exploration program are reviewed, and a typical AAP mission to the surface is outlined. M.G.J.

N68-33171*# National Aeronautics and Space Administration, Washington, D. C.
AUTOMATED SPACE SCIENCE MISSION REQUIREMENTS
Edgar M. Cortright *In its* Aerospace Electron. Systems Technol. 1967 p 17–56 (See N68-33169 20-30)

A review of the automated spacecraft flight record, from January 1958 to April 1967, indicates a 98% success record for the spinning or tumbling spacecraft, a 70% record for three-axis-stabilized spacecraft, and an overall record of 90% success. Statistics are also given on development cost and time, and useful lifetimes. Areas of space activities are projected for the 1967 through 1985 period, with the probable preferred orbits for each mission category indicated and the minimum acceptable mission lifetimes defined. The suitability of automated and manned spacecraft for these mission is assessed, and it is pointed out that the proper mix is a matter of judgment based on cost effectiveness, growth potential, and prestige. Objectives and requirements are discussed for the physics and astronomy program which is conducted with a diverse mix of earth satellites and deep space probes; the space applications programs pertaining to geodesy, communications and navigation, meteorology, and earth resources surveys; and

post-Apollo and planetary exploration programs. Candidate vehicles for future automated space missions are identified as Atlas–Centaur, Titan 3C–Centaur, Saturn 1B–Centaur, 6.5-m Saturn 4B–Centaur, and Saturn 5–Centaur. M.G.J.

N68-33172*# National Aeronautics and Space Administration, Washington, D. C.
ADVANCED TECHNOLOGY FOR AEROSPACE
Alfred J. Eggers *In its* Aerospace Electron. Systems Technol. 1967 p 57–74 (See N68-33169 20-30)

The decision making processes involved in identifying future missions for achieving national goals are discussed, along with the coordination efforts necessary for defining these goals. In the area of aeronautics, flight safety and aircraft utility are considered of major concern. The planning process for these programs is explained, and specific examples of work that has evolved from this process are given to show the relation between that type of work and achievement of objectives. The space technology program is planned in the context of over 50 attractive future missions identified by NASA in its internal planning activity, and in coordination with other Government agencies. Two examples are discussed: high-power, long-lifetime space power systems, and optical telescope technology for space astronomy. It is shown how these programs were related to mission requirements and how the program was configured to satisfy the corresponding technology objectives. Importance is attached to the commonality of technologies and the extent to which a given level of technology can be applied to systems, subsystems, or components appropriate to the entire spectrum of missions. M.G.J.

N68-33173*# National Aeronautics and Space Administration, Washington, D. C.
SPACEPOWER ADVANCED TECHNOLOGY PLANNING
William H. Woodward *In its* Aerospace Electron. Systems Technol. 1967 p 75–86 (See N68-33169 20-30)

Survey data are presented on the space power requirements for future unmanned science probe and orbiter missions, unmanned Application technology satellite S mission, and manned missions. Possible thermal energy source and photon energy source space power systems and components are depicted, and energy sources and conversion systems are listed. Eight systems of principal interest are discussed and their power range estimated. These include thermoelectric and Brayton isotope systems for low power ranges (below 10 kw); the thermoelectric, Rankine, and thermionic reactors for ranges above 10 kw; and batteries or fuel cells required for energy storage with all these systems, or as a short duration space power system. Technology ready dates are predicted. Large array technology is mentioned, and it is stated that a lightweight, solar, electric propulsion system weighing 35 kilograms per kilowatt, including the solar cell array, the thrusters, and the power conditioning, could be attained by about 1969–1970. M.G.J.

N68-33178*# National Aeronautics and Space Administration, Goddard Space Flight Center, Greenbelt, Md.
OPTICAL TECHNOLOGY FOR EXPERIMENTS AND APPLICATIONS IN CISLUNAR SPACE
Henry H. Plotkin *In its* Aerospace Electron. Systems Technol. 1967 p 139–152 (See N68-33169 20-30)

Several concepts and the technological problems involved, are discussed for diffraction-limited, large-aperture reflecting telescopes for space astronomy. Pulsed laser satellite ranging techniques are reviewed, and methods of improving range resolution are suggested. Continuous laser satellite tracking of passive reflecting satellites is discussed, and it is reported that a ground station is being built around an ionized argon laser. The station will provide for 4 watts of power at 4880Å to be intensity modulated with a tone of 136 MHz and beamed at the satellite. The need for improving lifetime, stability, and power output of the argon laser is noted. Also emphasized is the importance of studying the effect of the atmosphere on laser radiation if the use of ground stations in optical communication with spacecraft is contemplated. A 10.6-micron transmitter–receiver arrangement for heterodyne detection of coherent radiation reflected from a passive satellite is diagrammed. Other laser experiments in cislunar space are discussed. Optical ground station design is considered. M.G.J.

N68-33202*# National Aeronautics and Space Administration, Goddard Space Flight Center, Greenbelt, Md.
ORBIT INFORMATION DERIVED FROM ITS HODOGRAPH
J. B. Eades, Jr. Jul. 1968 40 p refs
(NASA-TM-X-63307; X-643-68-264) CFSTI: HC $3.00/MF $0.65 CSCL 22C

The hodograph representing a two-body motion can be utilized to develop analytic relations descriptive of this category of central field trajectories. In this paper a brief vector development is presented which leads directly to the hodograph; also several interesting results are obtained which connect the various angles of reference and the speed components for the flight path. A correlation between the hodographs, referenced to a moving axis system and an orbital fixed axis system is presented. Also, a geometric description of a correlation between the position angle of reference (true anomaly), the eccentric anomaly and the mean anomaly is developed. Author

N68-33214*# National Aeronautics and Space Administration, Goddard Space Flight Center, Greenbelt, Md.
A TECHNIQUE FOR LONG ARC FITTING AS APPLIED TO THE IMP 3 ORBIT
Barbara E. Lowrey Jul. 1968 10 p ref
(NASA-TM-X-63308; X-643-68-275) CFSTI: HC $3.00/MF $0.65 CSCL 22C

An investigation of the IMP 3 (Explorer 28) orbit has been performed in an attempt to find a long arc consistent with the short arcs. An arc spanning 120 orbits has been obtained which does not differ from the short arcs in predicting the time of perigee passage by more than one minute in time (out of an orbital period of 140 hours.) It is concluded that highly eccentric orbits provide an opportunity for accurate long term studies of orbit determination and that interesting insights may be obtained from such studies. Author

N68-33246*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
SPACE PROGRAMS SUMMARY NO. 37-51, VOLUME 1 FOR THE PERIOD MARCH 1 TO APRIL 30, 1968. FLIGHT PROJECTS
31 May 1968 43 p refs
(Contract NAS7-100)
(NASA-CR-96383; JPL-SPS-37-51, V. 1) CFSTI: HC $3.00/MF $0.65 CSCL 22A

Progress is reported for the Mariner Mars 1969 project, the Surveyor project, future projects, and advanced planetary missions technology. Project engineering, systems, guidance and control, and space sciences activities are reviewed for the planetary-interplanetary Mariner Mars program. A brief review is included for soft landing a series of spacecraft on the moon in support of the Apollo project. Long-range traverses on the lunar surface are considered as are a planetary vehicle thermal insulation system and the dissociation of atmospheric constituents during planetary entry. M.W.R.

N68-33288*# National Aeronautics and Space Administration, Goddard Space Flight Center, Greenbelt, Md.
AN ION-EXOSPHERE WITH VARIABLE CONDITIONS AT THE BAROPAUSE

R. E. Hertle Aug. 1968 29 p refs
(NASA-TM-X-63311; X-615-68-303) CFSTI: HC $3.00/MF $0.65 CSCL 03B

The model ion-exosphere of Eviatar, Lanchek and Singer for a nonrotating planet with a static, centered-dipole magnetic field is generalized by permitting the density and temperature to vary over the baropause. In particular, the density and/or temperature are allowed to differ at the conjugate magnetic field points of the baropause. For this case, the ion and electron velocity-distribution functions, satisfying the Vlasov equations in the drift approximation, are constructed. Species densities are determined from the distributions and compared with the corresponding results of Eviatar *et. al.* for the case of uniform density and temperature at the baropause. In addition, the particle current densities, pressures and temperatures are derived. Author

N68-33300*# Douglas Aircraft Co., Santa Monica, Calif. Space Sciences Div.
SURFACE-PARTICLE-INTERACTION MEASUREMENTS USING PADDLEWHEEL SATELLITES
Gordon S. Reiter (Hughes Aircraft Co., El Segundo) and Kenneth Moe Jul. 1968 14 p refs
(Contract NAS5-9324)
(NASA-CR-96310; Douglas Paper-5217) CFSTI: HC $3.00/MF $0.65 CSCL 22A

Surface-particle-interaction measurements have been carried out by utilizing the torque and drag force on two paddlewheel satellites with perigee altitudes between 250 and 300 km. The angular distribution of the re-emitted molecules was inferred to be nearly diffuse, and the accommodation coefficients were between 0.65 and 0.9. A proposed satellite experiment, Project ODYSSEY, is described in which the surface-particle-interaction and atmospheric parameters will be measured with much improved accuracy. Author

N68-33302*# California Univ., Berkeley. Space Sciences Lab.
EXPERIMENT DATA ANALYSIS REPORT. OGO-A EXPERIMENT NO. 1
Kinsey A. Anderson 10 Jun. 1968 6 p ref *its* Ser. 9, Issue 30
(Contract NAS5-2222)
(NASA-CR-98278) CFSTI: HC $3.00/MF $0.65 CSCL 22A

A scintillation counter on the OGO-A satellite, consisting of a CsI crystal surrounded by a plastic anticoincidence shield, was used in an experiment to detect 3 to 90 MeV protons in solar cosmic rays. Typical background counting rates of the OGO-A detector are indicated, and the various observed proton events are listed. The main problems in dealing with these data are that the anticoincidence shield did not function and that much of the time coverage of the events was very fragmentary. M.W.R.

N68-33307*# Volt Technical Corp., Washington, D. C.
RADIOASTRONOMICAL INVESTIGATIONS OF THE SMALL SCALE SPATIAL INHOMOGENEITIES' MOTIONS AND DIMENSIONS
V. V. Vitkevich and V. I. Vlasov Greenbelt, Md. NASA. Goddard Space Flight Center 22 Aug. 1968 5 p refs Transl. into ENGLISH from Dokl. Akad. Nauk SSSR, Ser. Astron. (Moscow), v. 181, no. 3, 1968 p 572–574
(Contract NAS5-12487)
(NASA-CR-98274; ST-RA-IS-10741) CFSTI: HC $3.00/MF $0.65 CSCL 03B

This work describes the use of a radioastronomical method for solar wind measurements. It has the advantage over standard rocket methods in that it allows the characteristics of the inhomogeneous electron component to be obtained. After unambiguous determinations of the diffraction pattern of linear dimensions, it becomes possible to derive the electron concentration. Author

N68-33310# Aerospace Corp., El Segundo, Calif.
A POLYNOMIAL FORCE MODEL REPRESENTATION FOR DETERMINING NEAR-EQUATORIAL, NEAR-SYSCHRONOUS SATELLITE ORBITS
Norman S. Hall and Robert A. Gersten May 1968 16 p refs
(Contract F04695-67-C-0158)
(TR-0158(3307-01)-19; SAMSO-TR-68-248; AD-671924)

A method for accurately determining the orbits of near-equatorial, near-synchronous satellites is presented. The basic approach is to supplement the conventional spherical harmonics representation of the terrestrial gravity field with a forcing function having components represented by polynomial expansions about nominal value of vehicular sub-latitude, sub-longitude, and separation from the geocenter. Numerical results are presented for a variety of near-equatorial, near-synchronous orbits. Author (TAB)

N68-33361*# Philco-Ford Corp., Palo Alto, Calif. Space and Re-entry Systems Div.
PROGRAM DESCRIPTION AND THEORETICAL BASIS FOR THE ORBIT DETERMINATION PROGRAM Final Report
Dec. 1967 244 p refs
(Contract NAS5-9939)
(NASA-CR-96322; TR-DA1508) CFSTI: HC $3.00/MF $0.65 CSCL 22C

Designed for postflight analysis, the orbit determination program system (ODP) consists of four computer programs for estimating space vehicle trajectories from tracking data of various types. These programs are: (1) The differential correction program (DCP), as the central ODP program, contains the logic and computations for the use of measurement values for the differential correction of an estimate of state. (2) The tracking data editing program (TDEP) decodes the data in the various formats, converts the data to a single fundamental set of units, and rewrites the data in a single format to simplify input procedures for the DCP. (3) The tracking data simulator (TDS) provides a means of supplying tracking data on each of the four types which can be processed by the DCP, and aids in exercising the various operating options of the DCP. (4) The residual output program (ROP) is designed to demonstrate the recovery of the state estimate and residual records from the tapes written by the DCP. Operation details are given on each program which, with few exceptions, is written in FORTRAN 4 for the IBM 7094 computer. Data are also included on the coordinate systems and transformations, estimation procedure, and measurement and dynamic models. (See N68-33362 and N68-33363.) M.G.J.

N68-33362*# Philco-Ford Corp., Palo Alto, Calif. Space and Re-entry Systems Div.
SUBROUTINE DESCRIPTIONS AND LISTINGS FOR THE ORBIT DETERMINATION PROGRAM. VOLUME 1 Final Report
Dec. 1967 269 p refs
(Contract NAS5-9939)
(NASA-CR-96356; TR-DA1509, V. 1) CFSTI: $3.00 CSCL 22C

Descriptions and block data listings are presented on the labelled commons used by the orbit determination program (ODP) for all communication of data between subroutines where common usage is indicated. Blank common is used only for temporary storage within a given subroutine, and never for communication. The descriptions contain general classifications of the data and detailed descriptions of the individual quantities. This volume contains subroutines A through F. For subroutines G through Z, see N68-33363. M.G.J.

N68-33363*# Philco-Ford Corp., Palo Alto, Calif. Space and Re-entry Systems Div.
SUBROUTINE DESCRIPTIONS AND LISTINGS FOR THE ORBIT DETERMINATION PROGRAM, VOLUME 2 Final Report
Dec. 1967 381 p refs
(Contract NAS5-9939)
(NASA-CR-96357; TR-DA1509, V. 2) CFSTI: $3.00 CSCL 22C

This volume contains subroutines G through Z. For subroutines A through F, see N68-33362.

N68-33371*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
ANALYSIS OF LAUNCH WINDOWS FROM CIRCULAR ORBITS FOR REPRESENTATIVE MARS MISSIONS
Larry A. Manning, Byron L. Swenson, and Jerry M. Deerwester Washington Sep. 1968 61 p refs
(NASA-TM-X-1651) CFSTI: HC $3.00/MF $0.65 CSCL 22C

Round-trip missions to Mars were investigated to define representative launch windows and associated ΔV requirements. The 1982 inbound and the 1986 outbound Venus swingby missions were selected for analysis and serve to demonstrate the influence of the characteristics of the heliocentric trajectories on the launch-window velocity requirement. The analysis investigated the use of optimum one- and two-impulse transfers, plus, a restricted three-impulse transfer employing an intermediate elliptic orbit to transfer from a circular parking orbit to the departure hyperbolic asymptote. Insertion at planet arrival was into an orbit coplanar with the arrival asymptote and any required plane change was performed during the planet departure phase. The study indicates that, with a three-impulse transfer, the ΔV penalty to provide a launch window of 20 days at Earth or 60 days at Mars is no more than 5 to 10 percent above the minimum coplanar requirement. Therefore, use in mission analyses of the coplanar ΔV requirements would not result in large errors if three-impulse transfers are acceptable. However, the results also show that the use of coplanar departure velocity requirements is not a good approximation for these launch windows with one- or two-impulse transfers. Author

N68-33375*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
ON A PERIODIC SOLUTION OF THE CENTRAL DIFFERENTIAL EQUATION IN THE RELATIVITY THEORY OF GRAVITATION
Abolghassem Ghaffari [1968] 4 p Presented at 12th Intern. Congr. of Appl. Mech., Stanford, Calif., 26–31 Aug. 1968
(NASA-TM-X-61158) CFSTI: $3.00 CSCL 03B

An investigation was conducted on the application of perturbation techniques to the central differential equation in the relativity theory of gravitation. Assuming the earth's gravitational field is spherically symmetric and the effect of the gravitational field of the sun on an artificial earth satellite is negligible; then the motion of an artificial earth satellite is governed by the ordinary geodesics of the Schwarzschild metric. An approximate periodic solution of the satellite orbit is obtained and it is shown that the frequency of the approximate solution is a function of the amplitude and eccentricity of the corresponding Keplerian orbit. Author

N68-33389 Texas Univ., Austin.
AN OPTICAL STUDY OF STELLAR FLARES
William Eckart Kunkel (Ph.D. Thesis) 1967 117 p
Available from Univ. Microfilms: HC $5.80/MF $3.00 Order No. 67-14858

Eleven flare stars were observed through at least two outbursts each during a stellar flares conducted at the McDonald Observatory in 1965 and 1966. To determine good statistics of flare incidence about 30 flares were recorded on each of the most intensively observed stars, AD Leo, YZ CMi, and Wolf 359, monitored in sequentially sampled U, B, V. To identify the emission processes responsible for flare light, time-resolved low resolution (260 A mm^{-1}) spectra were obtained of flares on EV Lac, AD Leo, and YZ CMi. The high rate of flare incidence raported in this study (up to one event per hour in the case of Wolf 359) is not due to unusual flare activity, but only to recognition of the spectral determinants governing the detection of flares, which give the U-band an advantage of 1.1 magnitudes over the B and 2.4 magnitudes over the V. Flare activity may be represented by a Poisson process wherein, per unit time, the mean number of flares observed to be brighter than a magnitude U varies exponentially with U. Dissert. Abstr.

N68-33435*# Yeshiva Univ., New York. Belfer Graduate School of Science.
PHYSICAL CONDITIONS IN THE PRIMITIVE SOLAR NEBULA
A. G. W. Cameron [1968] 10 p refs Presented at the Intern. Symp. on Meteorite Res., Vienna, 7–13 Aug. 1968
(Grant NGR-33-023-018)
(NASA-CR-96363; SM-109/56) CFSTI: HC $3.00/MF $0.65 CSCL 03B

Models of the primitive solar nebula have been constructed. A model is required to be in centrifugal equilibrium radially in the plane of the disk and in hydrostatic equilibrium perpendicular to the plane of the disk. The distribution of angular momentum per unit mass in the initial model is that appropriate to a fragment of a collapsing interstellar gas cloud. For a reasonable distribution of the angular momentum per unit mass, two solutions with centrifugal equilibrium are presented. One solution has a very flat surface density, which is unstable against many perturbations, and presumably forms a double star system. The other solution is much more axially condensed and is taken to be an approximate model of the primitive solar nebula. This model is formed as a result of a dynamical collapse process which produces initial interior temperatures in the vicinity of 10^4 °K. The collapse causes initial turbulence, and there is a resulting redistribution of angular momentum as a result of turbulent viscosity. Author

N68-33453*# Naval Research Lab., Washington, D. C. E. O. Hulburt Center for Space Research.
PHOTOGRAPHS OF CORONAL STREAMERS FROM A ROCKET ON 9 MAY 1967
R. Tousey, G. D. Sandlin, and M. J. Koomen Oct. 1967 8 p refs Presented at the Intern. Astron. Union Meeting, Symp. 35 on the Struct. and Develop. of Solar Active Reg., Budapest, 22–31 Aug. 1967
(NASA-CR-96359) CFSTI: HC $3.00/MF $0.65 CSCL 22A

The photographs taken from the white light coronographs are discussed with attention focused on the straight character of the streamers and to the possible origins of the three streamers which appear to come from regions not far from the North Pole. The simultaneous photographs are reproduced as unretouched, positive prints. A study of the streamers at high north latitudes showed that the NE streamer is single and appears to form a 21° angle with the solar axis; the NW streamer is double with angles of 20 and 27° to the solar axis. Results are also raported on an investigation which was made to determine whether or not intense active regions on the back side might have served as origins for these streamers. Tabulations are included on a calculation of the apparent angle between each streamer and solar axis. It is concluded that these streamers came from active centers that were 50° to 53° heliocentric angle behind the limb, and were radial. B.S.D.

N68-33457 Case Inst. of Tech., Cleveland, Ohio.
REFLECTION NEBULAE: SOME OBSERVATIONS AND SOME MODELS
Conrad Curtis Dahn (Ph.D. Thesis) 1967 236 p
Available from Univ. Microfilms: HC $10.80/MF $3.05 Order No. 67-16070

Photoelectric UBV photometry is presented for reflection nebulae IC 1435 (the nebula around Merope in the Pleiades), IC 4592 (the nebula around ν Scorpii), and IC 4604 (the nebula around ρ Ophiuchi). A first order scattering theory was employed to compute the variation in color and surface brightness with angular distance from the illuminating star for model nebulae consisting of a plane parallel, homogeneous layer of scattering particles. Spherical grains of dirty ice, an ice-like pure dielectric, graphite and graphite cores surrounded by ice mantles were considered. Mie's theory was used to calculate the scattering properties of the homogeneous particles; Guttler's theory was employed for the composite grains. The photometric parameters of the models were found to be most sensitive to: (1) the geometrical thickness of the nebula, (2) the optical thickness of the nebula, and (3) the location of the star with respect to the nebulosity. Dissert. Abstr.

N68-33604 National Lending Library for Science and Technology, Boston Spa (England).
PROBABLE PHASE DISTRIBUTION OF SPHERICAL STELLAR SYSTEMS AND THEIR CONDITIONS OF EXISTENCE [NAIVEROYATNEISHEE FAZOVOE RASPREDELENIE V SFERCHESKIKH ZVEZDNYKH SISTEMAKH I USLOVIYA EGO SUSHCHESTVOVANIYA]
V. A. Antonov Jul. 1968 15 p refs Transl. into ENGLISH from Vestn. Leningr. Univ. (Leningrad), v. 7, 1962 p 136–146
(RTS-4663) Available from Natl. Lending Library, Boston Spa, Engl.: 30s

In the Boltzmann theorem concerning the evolution of spherical systems, it is assumed that in the state of statistical equilibrium (in the absence of rotation) Maxwellian distribution is necessarily inherent at every spatial point. It is shown that the assumptions made by Boltzmann are insufficient in that stationary state with Maxwellian distribution of velocities is also a state of statistical equilibrium only in certain determined conditions. S.C.W.

31 SPACE VEHICLES

Includes launch vehicles; manned space capsules; clustered and multistage rockets; satellites; sounding rockets and probes; and operating problems. For basic research see: 30 Space Sciences. For related information see also: 28 Propulsion Systems; and 32 Structural Mechanics.

N68-32566# Technische Univ., Berlin (West Germany).
ASSESSMENT OF THE MAXIMAL TRANSPORT CAPACITY AND COMPARATIVE ANALYSIS OF ONE WAY TRANSPORT SYSTEMS BETWEEN MOON AND MARS [ABSCHAETZUNG DER MAXIMALEN TRANSPORTKAPAZITAET UND VERGLEICHENDE ANALYSE VON EINWEGTRANSPORTSYSTEMEN ZUM MOND UND MARS]
Juergen Bommer (Ph.D. Thesis) Dec. 1967 180 p refs In GERMAN
(D-83) CFSTI: HC $3.00/MF $0.65

The economy of manned space transportation systems is determined by their frequency of spaceship reuse and the connected transportation costs, especially for payloads in earth orbits. Models of one way space missions are formulated and used to obtain maximal transportation capacities necessary for the erection of settlements on Moon or Mars. Emphasis is placed on the available working force of engineers. The theoretical maximal transportation capacity developed for a settlement operation can accomodate 15×10^6 passengers over a time period of 25 years. Transl. by G.G.

N68-32727# Telcom Inc., Arlington, Va.
GEOSTATIONARY OPERATIONAL ENVIRONMENTAL SATELLITE (GOES) DATA COLLECTION SYSTEM. TASK 1: DEFINITION OF DATA COLLECTION SYSTEM Final Report
Nov. 1967 189 p refs
(Contract E-157-67(N))
(TER-129B; PB-178503) CFSTI: HC $3.00/MF $0.65

The geostationary operational environmental satellite (GOES) system is designed to provide emergency warning and environmental data collection and dissemination services. Under the control of a control and data acquisition ground terminal, the GOES will relay interrogation signals to a variety of remote sensor terminals, including balloons, buoys, river gauges, seismic sensors, and remote weather stations. These sensor terminals will automatically respond with a data message which will be relayed by GOES back to the CDA. Computing facilities associated with the CDA will perform such analysis and tabulation as required, then disseminate the data to users, either through GOES or by other communications links. Author (USGRDR)

N68-32728# Telcom, Inc., Arlington, Va.
GEOSTATIONARY OPERATIONAL ENVIRONMENTAL SATELLITE (GOES) DATA COLLECTION SYSTEM. TASK 2: DESIGN OF REMOTE AND MASTER TERMINALS Final Report
Dec. 1967 54 p refs
(Contract E-157-67(N))
(TER-133; PB-178504) CFSTI: HC $3.00/MF $0.65

The geostationary operational environmental satellite (GOES) system is designed to provide emergency warning and environmental data collection and dissemination services. The objective of Task 2 is to prepare specifications for a set of three ground terminals which will be used to verify GOES system design concepts in tests conducted with the Applications Technology Satellite, ATS-1 and ATS-3, which are in synchronous (24 hour) orbits at the same longitudes as the projected GOES vehicle. Author (USGRDR)

N68-32745*# Aztec School of Languages, Inc., Acton, Mass. Research Translation Div.
INVESTIGATION OF THREE-DIMENSIONAL DESCENT TRAJECTORIES OF LIFTING RE-ENTRY VEHICLES [UNTERSUCHUNG VON DREIDIMENSIONALEN ABSTEIGSBAHNEN FUR AUFTRIEBSERZEUGENDE RAUMFLUGKORPER]
W. Hein, F. Mysliwetz, and F. Oppelt Washington NASA Sep. 1968 26 p refs Transl. into ENGLISH from Rept. BMwF-FB-W-67-28, Munich, Sep. 1967 30 p
(Contract NASw-1692)
(NASA-TT-F-11907) CFSTI: HC $3.00/MF $0.65 CSCL 22B

For the second stage of an aerospace transport, descent trajectories and footprints have been determined at various banking angles and lift-drag ratios. The maximum longitudinal range that can be obtained under the assumptions made in this investigation amounts to 3/4 of the earth's equator, whereas a maximum cross range of 60° can be reached. Temperatures on the lower surface of the wing and at the stagnation point are about 150–200°K higher for the banked-entry maneuvers than for corresponding plane trajectories. Normal accelerations, though higher, remain under 3 G. Author

N68-33008*# Boeing Co., Seattle, Wash.
MAINTAINABILITY OF MANNED SPACECRAFT FOR LONG-DURATION FLIGHTS. VOLUME 1: SUMMARY REPORT
Washington NASA Aug. 1968 57 p refs
(Contract NAS2-3705)
(NASA-CR-1108; D2-113204-1) CFSTI: HC $3.00/MF $0.65 CSCL 22B

A 99% probability of crew survival is a basic constraint in the analysis. Spacecraft of four representative but widely varying missions, one Earth-orbital and one interplanetary each in the mid-1970 and mid-1980 time periods, are examined to the replaceable component level. Detailed maintenance analyses of subsystems and components, vehicle configuration optimizations performed with a unique computer program, and statistical results of several hundred mission simulations are described and evaluated. The effects of hardware reliability and failure rates, skills, environmental factors, mission durations and resupply potential, and various resources are considered in many interrelationships. Optimum distributions of redundant and spare items to be included on board each spacecraft configuration for assuring mission success are identified, and their implications as to operational requirements and design philosophies are discussed. Tables, charts, and graphs summarizing analytical results and displaying parametric sensitivities are provided. Gross cost estimates are also included to indicate trends and place the respective missions in context relative to each other. Author

N68-33060*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
MARINER VENUS 67. VOLUME 1: LAUNCH THROUGH MIDCOURSE MANEUVER Final Project Report
15 Jun. 1968 514 p refs
(Contract NAS7-100)
(NASA-CR-96382; JPL-TR-32-1203) CFSTI: HC $3.00/MF $0.65 CSCL 22B

This document covers the launch through the midcourse maneuver of Mariner V, the flight spacecraft of the Mariner Venus 67 project. Included in this document are a brief history of Mariner projects, the project objectives of Mariner Venus 67, and the mission description and characteristics of the Mariner Venus 67 project. Also included are sections on the overall project organization and management, the flight path analysis and mission planning, the spacecraft system, the launch vehicle integration, the mission operations system, and the mission-analysis preparations and activities during countdown and launch. Author

N68-33174*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
ORBITAL LABORATORY VEHICLE AND EXPERIMENT CONTROL
Peter R. Kurzhals *In its* Aerospace Electron. Systems Technol. 1967 p 89–99 (See N68-33169 20-30)

Vehicle and experiment control requirements for manned orbital laboratories are assessed. Research problems of concern are identified as follows: (1) In the disturbance area, improved definitions of crew motion and aerodynamic disturbance torques for large clustered spacecraft configurations are needed. (2) Vehicle attitude control will depend primarily on control moment gyro (CMG) systems. Wider CMG torque ranges will be required to cope with anticipated crew motion torques during fine control modes, and optimal torque implementation and desaturation techniques for particular missions will have to be defined. (3) Low-thrust jet or other desaturation systems must be developed and tested. (4) Experiment control will necessitate the development of both tracking and fine-pointing gimbal systems. (5) Accurate inertial and planetary sensing systems capable of long-term operation are required to support the experiment control function. Author

N68-33175*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
SATELLITE ATTITUDE SENSING AND CONTROL
Edwin C. Foudriat *In its* Aerospace Electron. Systems 1967 p 101–110 (See N68-33169 20-30)

General technology needs to meet future spacecraft control performance requirements are examined. As attitude-pointing accuracy is a key factor, accuracy criteria are defined for earth-oriented, inertial-oriented, and spin-stabilized spacecraft. The factors influencing sensor system accuracy are assessed, and the NASA program for horizon definition is used to illustrate the requirement for sensor source information. It is pointed out that further knowledge of sensor spatial intensity distribution will be required, since this factor limits the ultimate control system accuracy. Better detectors, more reliable scanning systems, better optical filters, and attenuators will also be required. In the area of control systems, the interactions and disturbances that arise because of the multipurpose use of spacecraft are discussed, and design methods are suggested to alleviate the problems. A spacecraft line-of-sight determination procedure is described to illustrate the complexity of data processing necessary to obtain geographical line of sight. The point is made that requirements to fulfill more difficult control spacecraft missions will demand complex onboard information processing systems. M.G.J.

N68-33332*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
ATLAS-CENTAUR FLIGHT PERFORMANCE FOR SURVEYOR MISSION B
Washington Sep. 1968 152 p refs
(NASA-TM-X-1616) CFSTI: HC $3.00/MF $0.65 CSCL 22D

The second operational Atlas-Centaur launch vehicle AC-7, with Surveyor SC-2, was launched on September 20, 1966. The flight profile was a direct-ascent mission to inject the Surveyor into a lunar intercept trajectory. Subsequent to injection, a vernier engine on the Surveyor failed to fire. The spacecraft tumbled out of control and failed to complete the mission. This report includes a flight performance evaluation of the Atlas-Centaur launch vehicle systems from lift-off through spacecraft separation and Centaur retromaneuver. Author

N68-33481*# Chrysler Corp., New Orleans, La. Space Div.
OPTICAL TECHNOLOGY APOLLO EXTENSION SYSTEM, PHASE A, VOLUME 1. SECTION 1 AND 2: PROGRAM RESULTS AND OPTICAL TECHNOLOGY DEVELOPMENT PLAN Final Technical Report
18 Aug. 1967 80 p
(Contract NAS8-20256)
(NASA-CR-61924) CFSTI: HC $3.00/MF $0.65 CSCL 22B

Future NASA space mission objectives were identified in order to assess the optical technology required and to outline a development program to provide this technology. Four major application areas are considered: astronomy, remote sensing, meteorology, and optical communications. Specific ground and space experiments are proposed and the relationship between these programs is examined. Also considered are alternatives for experiments, launch vehicles, spacecraft, spacecraft subsystems, and ground systems. Thirteen experiments, designed to compare alternative design approaches to technology development, are recommended: heterodyne detection on earth and on the spacecraft, direct detection, communication with 10 megahertz bandwidth, precision tracking of a ground beacon, point ahead and space-to-ground-to-space loop closure, precision tracking from one ground station to another, 10 micron phase and amplitude correlation, pulse distortion measurements, primary mirror figure test and correction, thin mirror nesting principle, fine guidance, and comparison of isolation techniques. M.G.J.

N68-33482*# Chrysler Corp., New Orleans, La. Space Div.
OPTICAL TECHNOLOGY APOLLO EXTENSION SYSTEM, PHASE A. VOLUME 2, SECTION 3: EXPERIMENTS Final Technical Report
18 Aug. 1967 358 p refs
(Contract NAS8-20256)
(NASA-CR-61925) CFSTI: HC $3.00/MF $0.65 CSCL 22B

As part of the program to justify optical propagation experiments, the status of turbulence theory and the empirical contributions needed are discussed, and the importance of obtaining spaceborne optical communication diagnostic data is stressed. The objectives of the optical propagation experiment group are identified as increased physical knowledge of the atmosphere, communication diagnostics, and assessment of precision pointing and tracking forms. None of these experiments are described to show why space testing is essential. In determining the requirements for spaceborne telescopes, experiment design studies led to the selection of 0.6328μ and 10.6μ downlinks, and 0.488μ and 0.6328 uplinks. Laser telescope systems are also described. Ground station criteria are defined, and experiment procedures are listed. Supporting analyses are included on pointing and tracking, and the optical propagation experiment. M.G.J.

N68-33483*# Chrysler Corp., New Orleans, La. Space Div.
OPTICAL TECHNOLOGY APOLLO EXTENSION SYSTEM, PHASE A, VOLUME 6, SECTION 6: RESOURCES ANALYSIS Final Technical Report
18 Aug. 1967 203 p
(Contract NAS8-20256)
(NASA-CR-61926) CFSTI: HC $3.00/MF $0.65 CSCL 22B

Resources analyses data are presented on the optical technology Apollo Extension System (OTAES) program study undertaken to establish the feasibility of providing advanced technology for developing an interplanetary laser communication system and a manned orbiting telescope. A program plan is included which depicts a feasible solution of the attendant problems as they are presently defined. A modified lunar module was arbitrarily selected as the baseline spacecraft configuration to demonstrate concept feasibility. Thirteen hard core space experiments are recommended; these are categorized as the laser group (nine experiments), the large optics group (two experiments), and the fine guidance and isolation comparison group (two experiments). The assumed schedule is 54 months from authority to proceed until the launch of the optical technology experiment spacecraft. The OTAES mission economic alternatives and program alternatives are discussed. Preliminary gross costs are estimated. M.G.J.

N68-33517*# Atkins and Merrill, Inc., Sudbury, Mass.
FABRICATION OF A 1/10 DYNAMICALLY SCALED GEOMETRICALLY SIMILAR, STRUCTURAL REPLICA OF THE APOLLO SERVICE MODULE SHELL AND STRUCTURE. PHASE 2 Final Report
Leo L. Hood [1968] 36 p
(Contract NAS9-4567)
(NASA-CR-92239) CFSTI: $3.00 CSCL 22B

Details are presented for a 1/10 scale, geometrically similar, structural replica of the Apollo service module shell along with an abbreviated lunar module cone extension for aft of the service module, a fairing between command service modules, and modified command module base plate and model sting. The outer curved panel shells, radial beams, reaction control system (RCS) panel shells, forward bulkhead panels, aft bulkhead panel assembly, and the interior shelf stiffeners and braces are also described, as are the simulation RCS engines and the simulated RCS and service module engine fuel tanks. The final model was instrumented by using strain gauges, accelerometers, and a thermocouple to record model response and temperature. A vibration test was performed to determine the integrity of the fasteners and structural components. M.W.R.

N68-33527# Aerospace Corp., El Segundo, Calif.
PROCEEDINGS OF THE SYMPOSIUM ON ATTITUDE STABILIZATION AND CONTROL OF DUAL-SPIN SPACECRAFT
Nov. 1967 268 p refs Symp. held in El Segundo, Calif., 1–2 Aug. 1967; Sponsored by AFSC
(Contract F04695-67-C-0158)
(TR-0158(3307-01)-16; SAMSO-TR-68-191; AD-670154)

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N68-33528# Radio Corp. of America, Princeton, N. J. Astro Electronics Div.

EARLY EVIDENCE OF STABILIZATION OF A VEHICLE SPINNING ABOUT ITS AXIS OF LEAST INERTIA

Vernon D. Landon *In* Aerospace Corp. Proc. of the Symp. on Attitude Stabilization and Control of Dual-Spin Spacecraft Nov. 1967 p 9–10 ref (See N68-33527 20-31)

A word picture is given of the physical aspects of spin stabilization. The motion of a single rigid body is discussed first as a means of leading up to an understanding of the attitude stabilization and control of dual spin spacecraft. Author

N68-33529# Hughes Aircraft Co., El Segundo, Calif. Satellite Systems Labs.

SIMULATION RESULTS FOR A DUAL-SPIN SPACECRAFT

J. R. Velman *In* Aerospace Corp. Proc. of the Symp. on Attitude Stabilization and Control of Dual-Spin Spacecraft Nov. 1967 p 11–23 refs (See N68-33527 20-31)

A digital computer program to simulate the motion of a dual-spin spacecraft is described. The simulation includes the effects of a sampled-data despin control system as well as the effects of energy-dissipative devices on the rotor and on the platform. Results of attitude stability simulation are compared with predictions of reaction torque arguments. Results showing satellite attitude stability are presented for the satellite with the active despin control system both with and without rotor unbalance. Author

N68-33530# Aerospace Corp., El Segundo, Calif. Guidance and Control Subdiv.

THE DETERMINATION BY FLOQUET ANALYSIS OF THE EFFECTS OF ENERGY DISSIPATION ON THE ATTITUDE STABILITY OF DUAL-SPIN SATELLITES

D. L. Mingori *In its* Proc. of the Symp. on Attitude Stabilization and Control of Dual-Spin Spacecraft Nov. 1965 p 25–36 refs (See N68-33527 20-31)
(Contract AF 04(695)-1001)

The attitude behavior of a dual-spin satellite with a damping mechanism on each of its rotating sections is investigated by means of Floquet theory. Parameter selections for the Floquet study are guided by the results of a preliminary analysis which employs the method of Routhian arrays. Several numerical examples are presented and the results obtained are compared with predictions based on various approximate analyses. Although this comparison generally reveals at least qualitative agreement, it is found in some cases that the limitations of the approximate analyses make it advisable to confirm the suitability of a preliminary design by means of more exact methods such as the Floquet procedure described in this paper. Substantial support is provided for the proposition that properly designed dual-spin spacecraft can be asymptotically stable in spin about the centroidal principal axis of minimum as well as maximum moment of inertia even in the presence of energy dissipation. Author

N68-33531# Philco-Ford Corp., Palo Alto, Calif. Space and Re-Entry Systems Div.

PARAMETER SELECTION FOR A CLASS OF DUAL-SPIN SATELLITES

P. M. Barba, W. W. Hooker, and I. Leliakov *In* Aerospace Corp. Proc. of the Symp. on Attitude Stabilization and Control of Dual-Spin Spacecraft Nov. 1967 p 37–44 refs (See N68-33527 20-31)

This work considers the selection of damper characteristics required to minimize the nutation damping time of a satellite spinning about the axis of least moment of inertia, in the presence of energy loss produced by propellant slosh in an idealized tank. The damper is of the pendulum type and is mounted on an antenna platform which is despun relative to the satellite. Damper parameters are obtained numerically for a range of satellite inertia distributions. The performance of the system is evaluated as a function of propellant depletion, and digital simulation results are presented to illustrate the vehicle attitude behavior. Author

N68-33532*# Ball Bros. Research Corp., Boulder, Colo.

INTERACTIONS BETWEEN A POINTING CONTROL SYSTEM AND THE NUTATIONAL MOTION OF A DUAL-SPIN SPACECRAFT

T. M. Spencer *In* Aerospace Corp. Proc. of the Symp. on Attitude Stabilization and Control of Dual-Spin Spacecraft Nov. 1967 p 45–71 refs Sponsored by NASA (See N68-33527 20-31)

This paper treats interactions between a biaxial pointing control system and the nutational motion of a dual-spin spacecraft like the Orbiting Solar Observatory (OSO). The interactions are investigated with the aid of a digital computer simulation of the spacecraft and control system. Nutation is damped in some situations, while it is driven in others. The interactions are influenced by changes in the moments of inertia of the spacecraft bodies, the wheel spin rate, and parameters which describe the elevation servo and friction in the elevation bearing. Author

N68-33533# TRW Systems, Redondo Beach, Calif. Space Vehicle Div.

VISCOUS RING PRECESSION DAMPER FOR DUAL-SPIN SPACECRAFT

Robert S. Taylor and John J. Conway *In* Aerospace Corp. Proc. of the Symp. on Attitude Stabilization and Control of Dual-Spin Spacecraft Nov. 1967 p 75–80 refs (See N68-33527 20-31)
(Contracts AF 04(695)-923; CSC-SA-6)

A nutation damper for single or dual spin stabilized spacecraft is described. The damper consists of a toroidal ring completely filled with a viscous fluid. Motion of the fluid in the ring is induced by precession of the spacecraft and energy is dissipated through viscous fluid friction. The damper has many advantages over the more complex resonant precession dampers. Damper performance is presented and discussed based on the energy dissipation approach of Thomas and Reiter. Analytical and test data are compared and curves are presented for preliminary sizing of a spacecraft damper. Author

N68-33534# Philco-Ford Corp., Newport Beach, Calif. Guidance and Control Dept.

DESIGN AND ANALYSIS OF BALL-IN-TUBE NUTATION DAMPERS

Richard R. Auelmann and Phillip T. Lane *In* Aerospace Corp. Proc. of the Symp. on Attitude Stabilization and Control of Dual-Spin Spacecraft Nov. 1967 p 81–91 refs (See N68-33527 20-31)
(Contracts N173-31500; N00173-67-C-0981)

This paper deals with the dynamics of a ball-in-tube nutation damper of the type used on the Telstar satellite. The system equations are derived using a quasi-Lagrangian formulation. Evans' root lucus method is used to establish the regions of stability and to provide a quantitative measure of the accuracy of the energy-sink approximation. Design curves for the entire range of parameters are presented in a novel way. Finally, a criterion for selecting the gap size and the fluid viscosity is given. The methods of analysis can be applied to other damper configurations as well. Author

N68-33535*# Ball Bros. Research Corp., Boulder, Colo.

CANTILEVERED-MASS NUTATION DAMPER FOR A DUAL-SPIN SPACECRAFT

T. M. Spencer *In* Aerospace Corp. Proc. of the Symp. on Attitude Stabilization and Control of Dual-Spin Spacecraft Nov. 1967 p 91–109 refs Sponsored by NASA (See N68-33527 20-31)
CSCL 22B

This paper describes a nutation damper identical in principle to that used on the Orbiting Solar Observatory (OSO). The damper is a passive mechanical device consisting of a cantilevered mass that is free to move in a case filled with viscous fluid. When mounted on the despun portion of a dual-spin spacecraft, the damper operates in conjunction with the despin servo to form a "Semi-passive" nutation control system. This system damps nutation whether the spin moment of inertia of the spinning body is larger or smaller than the transverse moments of inertia of the spacecraft. System performance is estimated in a simplified analysis. A "modified-energy-sink" argument and a "damping-torque" agrument are presented to arrive independently at the performance estimate. A number of characteristics of the cantilevered-mass nutation damper which might lead to its selection over other types, are presented. Author

N68-33536*# General Electric Co., Philadelphia, Pa. Missile and Space Div.

AN ACTIVE NUTATION CONTROL FOR A SPINNING SPACECRAFT

A. Connolly *In* Aerospace Corp. Proc. of the Symp. on Attitude Stabilization and Control of Dual-Spin Spacecraft Nov. 1967 p 111–118 refs (See N68-33527 20-31)
(Contract NASw-1410) CSCL 22B

This paper describes an active nutation control which was designed for possible application to NASA Goddard's ATS F/G Spacecraft. In the design studied, the Spacecraft is stabilized by spinning about its axis of least moment of inertia for approximately 40 hours during the transfer orbit to synchronous altitude and during orbit synchronization by vernier thrusting after kick stage firing. The control system uses a sensor which measures angular acceleration about a transverse body axis, and a hydrazine thruster which operates in a pulsed mode to reduce nutation below a threshold level. The effect of alignment tolerances on sensor output signal levels for rate gyros, linear accelerometers, and angular accelerometers mounted away from the vicinity of the spacecraft center of mass is discussed; it is concluded that in this application accelerometers are less sensitive to misalignment than gyros, and that an angular accelerometer provides greater freedom of mounting location than a linear accelerometer. The effects of sensor lag and reaction jet time delay on system performance are also discussed and it is shown that for many practical applications these effects can be compensated for by appropriate actuator location. Operation of the nutation damper during open-loop precession maneuvers is described. Author

N68-33537# Ball Bros. Research Corp., Boulder, Colo. Advanced Programs Dept.

A MAGNETIC CONTROL SYSTEM FOR AN EARTH POINTING SATELLITE

D. Sonnabend In Aerospace Corp. Proc. of the Symp. on Attitude Stabilization and Control of Dual-Spin Spacecraft Nov. 1967 p 121–144 refs (See N68-33527 20-31)

A satellite attitude control system is described using only a single magnetic torquing coil for spin axis direction and spin rate control. The satellite configuration is a dual-spin type, such as OSO, in which the spin axis is normal to the orbit plane, and the despun body is pointed at the center of the earth. The coil is mounted in the despun body so that the direction of its magnetic moment lies on the satellite roll axis. A torque motor connecting the two bodies is used to control the pitch error despun body. All other attitude and spin rate errors are corrected by judicious control of current in the coil. The theory, sensor complement, design, perturbation analysis, and simulation of the control law are all covered in this paper. Author

N68-33538# Hughes Aircraft Co., El Segundo, Calif. Systems Analysis Section.

DESIGN CONSIDERATIONS FOR SPIN AXIS CONTROL OF DUAL-SPIN SPACECRAFT

R. J. Mc Elvain and W. W. Porter *In* Aerospace Corp. Proc. of the Symp. on Attitude Stabilization and Control of Dual-Spin Spacecraft Nov. 1967 p 145–158 refs (See N68-33527 20-31)

The spin axis and velocity control system design considerations for dual-spin spacecraft are described. These design considerations are natural extensions of the technology developed at Hughes Aircraft Company for spin-stabilized vehicles such as Syncom, Intelsat II, and the Applications Technology Satellites. In most cases, the spin axis and velocity control system can employ many of the same hardware elements as for pure spinners to achieve the performance requirements. A typical example is treated in which the design considerations for a hypothetical synchronous altitude satellite mission are discussed. The example emphasizes those aspects peculiar to the dual-spin configuration. The primary differences which affect the north-south spin-axis orientation accuracy are the alignment and runout of the bearing assembly which connects the spinning and despun sections, and the large solar torque effects on the spacecraft. These and other considerations are treated in some detail via the example spacecraft and mission, and serve to illustrate the application of these techniques for spin axis and velocity control. Author

N68-33539# Ball Bros. Research Corp., Boulder, Colo. Control Systems Design Section.

APPROACHES TO THE SOLUTION OF THE DESPIN CONTROL PROBLEM

A. M. Muckle and M. Harris *In* Aerospace Corp. Proc. of the Symp. on Attitude Stabilization and Control of Dual-Spin Spacecraft Nov. 1967 p 159–172 refs (See N68-33527 20-31)

An important adjunct to all dual-spin attitude control systems is the "despin" or pitch controller. This paper describes a class of pitch control systems which maintains the alignment of a reference vector in the despun portion in a plane containing the spin axis and the center of the earth (or similar target). The system is viewed as a spinning wheel surrounding a shaft that terminates in a flange which attaches the despun body. The input information is assumed to be generated by horizon sensors rigidly mounted to the spinning body. Three pick-off devices have been considered: (1) a simple blipper that gives a single pulse when a reference mark on the shaft is aligned to a reference on the wheel; (2) an analog resolver that gives a voltage proportional to the sine of the angle between the wheel and shaft; and (3) an incremental digital encoder that produces a pulse each time the wheel-shaft angle changes by $\Delta\theta$. The third method receives the majority of attention. Author

N68-33540# Hughes Aircraft Co., El Segundo, Calif. Systems Analysis Section.

DESPIN CONTROL FOR DUAL-SPIN SPACECRAFT CONFIGURATION

R. J. Mc Elvain and A. Y. Kushi *In* Aerospace Corp. Proc. of the Symp. on Attitude Stabilization and Control of Dual-Spin Spacecraft Nov. 1967 p 173–184 refs Sponsored in part by AF (See N68-33527 20-31)

A control system is described which is designed to mechanically despin an earth-oriented payload from a dual-spin satellite configuration in sychronous earth orbit. The line-of-sight (LOS) pointing requirements are established for a specific mission, and the despin control loop tradeoffs which led to a particular control loop mechanization for that mission are discussed. The selected control looo configuration is a single-loop, sampled-data system, which utilizes processed outputs of a spinning earth sensor to determine LOS error. The performance characteristics of this

despin control system for the particular parameters of the spacecraft and mission are described. Finally, a single axis despin control experiment is summarized. This experiment was performed by Hughes Aircraft Company and demonstrated LOS pointing significantly better than the ±0.5 degree required for the specific mission described here. Author

N68-33541# Aerospace Corp., El Segundo, Calif. Guidance and Control Subdiv.

DUAL REACTION WHEEL CONTROL OF SPACECRAFT POINTING

Richard M. Terasaki *In its* Proc. of the Symp. on Attitude Stabilization and Control of Dual-Spin Spacecraft Nov. 1967 p 185–196 (See N68-33527 20-31)

(Contract F04695-67-C-0158)

A method of spacecraft pointing control by the use of two body-fixed reaction wheels is proposed, and the development of an appropriate set of control laws, design relationships, and a performance analysis of a sample design are presented. One reaction wheel, designated as primary, is to spin at a nominal, non-zero constant speed and, by itself, is a basis for a momentum bias or spin-despin type of attitude stabilization. A second wheel is mounted in the spacecraft so that its spin axis is perpendicular to that of the primary wheel. The inclusion of the second wheel and control if its speed enhances the spin-despin control system capabilities in two respects: (1) provision for precise attitude maneuverability, and (2) rapid damping of nutation. Author

N68-33542# TRW Systems, Redondo Beach, Calif. Control Systems Lab.

DYNAMIC DESIGN AND PERFORMANCE OF THE ADVANCED VELA CONTROL SYSTEM

D. C. Kirby and Y. Wakamiya *In* Aerospace Corp. Proc. of the Symp. on Attitude Stabilization and Control of Dual-Spin Spacecraft Nov. 1967 p 197–219 ref (See N68-33527 20-31)

(Contract AF 04(695)-923)

The Vela Advanced Spacecraft Program Satellites are a special case of the dual-spin principle in which the main satellite structure and a reaction wheel spin in opposite directions to one another. When "on station" in the satellite's earth-pointing mode, the net momentum in the local vertical direction is nominally zero, which permits local vertical orientation to be maintained without requiring processing torques. When injected into orbit, the satellite is spin-stabilized. Before achieving final earth-pointing mode, the satellite's attitude control system must sequence the satellite through a despin mode, reducing the spin rate to approximately 1 rpm; a sun-acquisition and earth-search mode; and a transitory earth-acquisition mode. This paper briefly reviews the synthesis of the control system as dictated by these requirements and other mission constraints, and presents the results of analytical studies supporting the design. In some instances, analytically predicted behavior of the satellite motion is compared with flight data. Author

N68-33543*# Ball Bros. Research Corp., Boulder, Colo. Advanced Program Dept.

THE ORBITING SOLAR OBSERVATORY

J. O. Simpson *In* Aerospace Corp. Proc. of the Symp. on Attitude Stabilization and Control of Dual-Spin Spacecraft Nov. 1967 p 223–234 refs Sponsored by NASA (See N68-33527 20-31)

The Orbiting Solar Observatory, a dual-spin spacecraft used for solar physics investigation from low earth orbit, is described. Considerations leading to the choice of a dual-spin configuration are discussed, and orbital performance of three OSO spacecraft is described. Applications of the OSO dual-spin design to other missions are described. Author

N68-33544*# Radio Corp. of America, Princeton, N. J. Spacecraft Systems Engineering.

STABILITE–APPLICATION OF MOMENTUM EXCHANGE TO SECOND-GENERATION WEATHER SATELLITES

J. E. Keigler and H. Perkel *In* Aerospace Corp. Proc. of the Symp. on Attitude Stabilization and Control of Dual-Spin Spacecraft Nov. 1967 p 235–242 refs (See N68-33527 20-31)

(Contract NAS5-9034)

The second-generation meteorological spacecraft to be deployed on an operational basis by the United States will provide three-axis attitude control for the several diverse meteorological sensors. Stabilite is the name given to this control system. Since the free-body vehicle dynamics of this advanced spacecraft are similar to those of the predecessor spin-stabilized vehicles, the attitude-control system incorporates many of the same principles and much of the same hardware even though the spacecraft configuration is entirely different. A single rotating flywheel stores angular momentum for gyroscopic stability, effects momentum interchange, and provides attitude-sensor scan. Magnetic torquing against the earth's field changes the magnitude and direction of the stored angular momentum. A passive fluid damper removes free-body motion about axes perpendicular to the direction defined by the angular-momentum vector. Magnetic torquing through ground command maintains the angular momentum parallel to the orbit normal. Momentum interchange, controlled by a closed loop through an earth scanner and motor, drives the payload at one revolution per orbit. Thus the Stabilite control system directs a sensor platform to be earth-oriented throughout its mission life. Author

N68-33545# TRW Systems, Redondo Beach, Calif. Electronic Systems Div.

THE ADVANCED VELA SPACECRAFT: A SPINNING ZERO-MOMENTUM VEHICLE

W. H. White *In* Aerospace Corp. Proc. of the Symp. on Attitude Stabilization and Control of Dual-Spin Spacecraft Nov. 1967 p 243–255 refs (See N68-33527 20-31)

(Contract AF 04(695)-923)

Two spacecraft are launched in tandem into a highly elliptical orbit by the Titan IIIC. The orbit of each spacecraft is circularized at 60,000 n mi by an onboard solid injection rocket. The Launch 4 spacecraft is a spinning vehicle with an internal, counter-rotating reaction wheel. The reaction wheel is sized to cancel the momentum of the spinning body, yielding a turning, zero-momentum vehicle. The spin axis is oriented toward the earth. The spacecraft body rotates about local vertical at 1 rpm with the spin speed controlled via the spacecraft clock and a sun reference. Spin speed corrections are made by nitrogen-gas jets. The attitude control system supplies earth-pointing errors and vehicle-spin-angle information ot the ground-generated ephemeris data are used to provide an unambiguous read-out of the spacecraft earth-pointing angle. In this paper, the advantages and disadvantages of the dual-spin, zero-momentum system are discussed along with the reasons given for its application to the Launch 4 vehicle. Author

N68-33546# Hughes Aircraft Co., El Segundo, Calif. Advanced Design Dept.

HUGHES GYROSTAT SYSTEM

A. J. Iorillo *In* Aerospace Corp. Proc. of the Symp. on Attitude Stabilization and Control of Dual-Spin Spacecraft Nov. 1967 p 257–266 refs (See N68-33527 20-31)

A dual-spin satellite configuration is described which has been recently developed for application to missions requiring precise pointing of large payloads. Author

N68-33553*# National Aeronautics and Space Administration, Washington, D. C.
SURVEYOR 7 Preliminary Report
May 1968 304 p refs
(NASA-SP-173) CFSTI: HC $3.00/MF $0.65 CSCL 22B

Principal scientific results are presented on the Surveyor 7 which successfully landed on the outer rim flank of the large crater Tycho in the southern part of the moon. The extensive data obtained from television observations and measurements of the lunar surface are analyzed to determine the mechanical properties, surface temperatures and thermal characteristics, electromagnetic properties, and radar reflectivity. Details are also given on the surface sampler and the alpha scattering experiment; preliminary results of the chemical analyses of these lunar soil samples are presented. Implications of the alpha scattering experiment are discussed in relation to lunar landing sites. Postlanding tracking acquisition and analysis to determine the selenocentric location of the probe are described. The ability of earth stations to direct very narrow laser beams to a specific location on the lunar surface was verified. B.S.D.

N68-33593*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
DEVELOPMENT OF METEOROLOGICAL SATELLITES IN THE UNITED STATES
William Nordberg Aug. 1968 19 p refs
(NASA-TM-X-63313; X-620-68-311) CFSTI: HC $3.00/MF $0.65 CSCL 22B

The basic concept of meteorological satellites is discussed in terms of the Tiros series, and the progressive technological advancements which resulted in the launch of Essa to initiate the series of Tiros operational satellites (TOS). The role of the Applications Technology satellites in making cloud cover observations is also discussed. Details are given on the Nimbus series of global meteorological observations. The systems design is based on a spacecraft capable of delivering on the order of 200 watts of electrical power to the experiments; a mechanical structure which can accommodate a maximum number of experimental instruments and which can be pointed at the earth at all times with an accuracy of about 1°; a stable and moderate thermal environment; and a data system which can acquire and store on the order of 10^9 to 10^{12} bits per orbit and transmit these data to the ground over Alaska, and which can transmit continuously a lesser amount of data. By placing the spacecraft into a sun synchronous orbit at a height of about 1100 km, the Nimbus can observe practically all points on the globe at least twice during every 24-hour period. Experimental results are assessed, and plans for the second generation of satellites are proposed. M.G.J.

32 STRUCTURAL MECHANICS

Includes structural element design and weight analysis; fatigue; thermal stress; impact phenomena; vibration; flutter; inflatable structures; and structural tests. For related information see also: 17 Materials, Metallic; and 18 Materials, Nonmetallic.

N68-32252 California Univ., Berkeley.
RESPONSE OF BEAMS WITH VISCOELASTIC LAYERS TO RANDOM LOADING
Ahmed Shawky Ibrahim Hammoud (Ph.D. Thesis) 1966 86 p
Available from Univ. Microfilms: HC $4.60/MF $3.00 Order No. 67-8570

Two different approaches, based upon appropriate sets of equations of motion, are adapted in the structural damping analysis of composite beams. In the first approach, a two-dimensional solution is obtained from the wave equations in the plane stress case, for the problem of vibration of beams made of n elastic layers. In the second approach, a one-dimensional solution is derived from the principle of minimum potential energy, for the case of a symmetrically arranged three-layered beam. The complex modulus is used to specify the elastic and damping properties of the viscoelastic material. The mean square displacements, bending moments, and shearing forces are calculated for the case of a single layered beam (two-dimensional solution) made of a viscoelastic material, and for the symmetrically arranged three-layered beam (one-dimensional solution) with viscoelastic damping in the middle layer, due to continuous load completely random in space and time. Dissert. Abstr.

N68-32258 Northwestern Univ., Evanston, Ill.
A VARIATIONAL METHOD FOR THE LIMIT ANALYSIS OF ROTATIONALLY SYMMETRIC SANDWICH SHELLS
Robert Henry Bryant (Ph.D. Thesis) 1967 77 p
Available from Univ. Microfilms: HC $4.20/MF $3.00 Order No. 67-15196

In classical limit analysis of a perfectly plastic structure, the prescribed loading is monotonically increased until plastic collapse impends. The safety factor is then defined as the ratio of the plastic collapse load to the prescribed load. It was shown that the safety factor can be bounded from below by a statically admissible multiplier, and from above by a kinematically admissible multiplier. The statically admissible multiplier is associated with a stress field that satisfies the equilibrium and stress boundary conditions, and does not violate the yield criterion. It is shown that for collapse to occur in a rotationally symmetric sandwich shell, both sheets of the shell must yield simultaneously in some region. The treatment of a line of discontinuity in the velocity field is discussed and the yield condition on the line of discontinuity is obtained from the general yield hypersurface by projections on appropriate hyperplanes in the stress space. Dissert. Abstr.

N68-32347 National Lending Library for Science and Technology, Boston Spa (England).
THE EFFECT OF VARIOUS FACTORS ON THE SENSITIVITY OF HEAT RESISTING MATERIALS TO STRESS CONCENTRATION AT HIGH TEMPERATURES [VLIYANIE RAZLICHNYKH FAKTOROV NA CHUVSTVITEL'NOST' ZHAROPROCHNYKH MATERIALOV K KONTSTENTRATSII NAPRYAZHENII PRI VYSOKIKH TEMPERATURAKH]
A. V. Stanyukovich and A. A. Chizhik Mar. 1968 18 p refs Transl. into ENGLISH from the book "Termoprochnost Material. i Konstrukts. Elementov" Kiev, Izd. Naukova Dumka, 1965 p 147–156
(RTS-4406) Available from Natl. Lending Library, Boston Spa, Engl.: 25s

Tests were conducted to determine the effects of notch geometry, temperature, and stiffness of the stress state on the notch sensitivity of heat resistant materials. To approximate test conditions with those encountered in actual operation, the working capacity of the materials are assessed for cases where stress concentrations do not cause any considerable reduction in creep strain in the area considered. Using the theory of elasticity, equations are derived for calculating the approximate stress concentration factor for normal stresses in the bottom of a helical notch. Tests were also conducted to study the effects of notch depth and radius of the rounded bottom of the notch sensitivity and material ductility. Data correlations show that the elastic stress concentration factor should not be applied as criteria for assessing the notch effect on the strain capacity of materials; the solution should be sought in the stiffness aspect (three-dimensionality) of the stress state generated by it. M.G.J.

N68-32350 National Lending Library for Science and Technology, Boston Spa (England).
THE FORMATION OF A DEFECT FIELD ON MAGNETIZATION OF A SPECIMEN BY A MOVING FIELD FROM A LOCALIZED SOURCE [FORMIROVANIYE POLYA DEFEKTA PRI NAMAGNICHENII OBRAZTSA DVIZHUSH-CHIMSYA POLEM LOKAL'NOGO ISTOCHNIKA]
I. V. Miroshin Nov. 1967 10 p refs Transl. into ENGLISH from Izv. Vuz. Fiz. (USSR), v. 1, Jan. 1967 p 5–11
(RTS-4159) Available from Natl. Lending Library, Boston Spa, Engl.: 17s 6d

Experimental material is presented which gives an indication of the mechanism of formation of a transverse crack field in a specimen when magnetized by a field from a localized source moving along the length of the specimen. The causes which establish the field around the transverse crack upon magnetization are analyzed by magnetization oscillograms of sections close to the boundaries of the cracks in a specimen from a rail. During the experiments the detecting magnet was moved at speeds up to 25 km/hour.
Author

N68-32385 National Lending Library for Science and Technology, Boston Spa (England).
SOLUTION OF THE PLANE PROBLEM OF THE THEORY OF ELASTICITY FOR A STRESSED ANNULAR SECTOR [RESHENIE PLOSKOI ZADACHI TEORII UPRUGOSTI DLYA KOL'TSEVOGO SEKTORA V NAPRYAZHENIYAKH]
A. A. Babloyan Mar. 1968 22 p refs Transl. into ENGLISH from Izv. Akad. Nauk Arm. SSR, Ser. Fiz.-Mat. Nauk (Armenian SSR), v. 15, no. 1, 1962 p 87–101
(RTS-4114) Available from Natl. Lending Library, Boston Spa, Engl.: 27s 6d

In this work we give the exact solution of the plane problem of the theory of elasticity for a stressed annular sector bounded by two concentric circles and two radii, when the external load is distributed symmetrically about the x axis. For the sake of convenience special forms of functions are used in solving the problem. It is shown that the system of these functions is orthogonal and complete in the region considered. The problem is reduced to the solution of infinite systems of linear equations. It is shown that the systems thus obtained are regular and have free terms bounded from above.
Author

N68-32441 National Lending Library for Science and Technology, Boston Spa (England).
MATERIALS
A. F. Maier 30 May 1968 5 p Transl. into ENGLISH from VDI (Ver. Deut. Ing.) Z. (Duesseldorf), v. 109, no. 29, Oct. 1967 p 1407–1411
(NEL-TT-1985) Available from Natl. Lending Library, Boston Spa, Engl.

Results are cited for various theoretical and experimental investigations into pressure effects on metals. Topics mentioned include: hydrostatic and high pressure effects, deformation, shock wave effects, pressure apparatus development, yield strength tests, and use of high pressure in chemical processes.
E.C.

N68-32501 National Lending Library for Science and Technology, Boston Spa (England).
PRECISE CALCULATION OF OPTIMUM DIAMETER RATIOS OF EXTERNALLY HEATED TUBES WITH INTERNAL PRESSURE [DIE EXAKTE BERECHNUNG DES OPTIMAIEN DURCHMESSERVERHAELTNISSES AUSSENBEHEIZTER ROHRE UNTER INNENDRUCK]
E. Ulrich 14 Feb. 1968 13 p refs Transl. into ENGLISH from Mitt. Ver. Grosskesselbesitzer (Duesseldorf), v. 56, 1958 p 354–357 In GERMAN and ENGLISH
(EE-TRANS-1711) Available from Natl. Lending Library, Boston Spa, Engl.

By the optimum diameter ratio of externally heated tubes with internal pressure one understands the limiting ratio of d_a/d_i up to which an increase in the thickness of the wall (at d_i constant) has some purpose in the reduction of the maximum total stress of the material. If one exceeds this ratio then the total stress increases, although the wall thickness is increased. An exact calculation of this optimum diameter ratio is given by means of the addition theorem of comparative stresses and both this and an exact distribution of stresses in such a tube are explained in a specific example. Futhermore the $p\text{-}\vartheta_a$ diagram of optimum diameter ratio is outlined, in which the relationship between pressure, stress, temperature difference and optimum diameter ratio is shown graphically. Such a diagram may be used for developing high pressure boiler construction, since at the optimum diameter ratio a boiler tube withstands maximum pressure and maximum temperature difference (heat transfer) at a certain permissible stress.
Author

N68-32538# Stanford Univ., Calif. Dept. of Aeronautics and Astronautics.
THE AXISYMMETRIC BUCKLING OF INITIALLY IMPERFECT COMPLETE SPHERICAL SHELLS
Tatsuzo Koga and Nicholas J. Hoff May 1968 142 p refs
(Contract N00014-67-A-0112-0003)
(SUDAAR-332; TR-21; AD-671833)

A theoretical investigation of the axisymmetric buckling of complete thin-walled spherical shells under uniform external pressure is undertaken to determine the effect of axisymmetric initial imperfections. In the analysis, the complete spherical shell is divided into two parts; the shallow cap in which the initial imperfection exists, and the remaining portion of the shell most of which deforms in simple contraction. The rotation of the meridian of the cap is assumed in the form of a polynomial function. Four matching conditions are enforced at the juncture of the cap and remainder. The total potential energy of the complete spherical shell is minimized in accordance with the Rayleigh-Ritz approximation method. Two types of initial imperfections are studied; one is an axisymmetric dimple, and the other is a spherical region whose radius of curvature is greater than that of the perfect spherical shell. The maximal values of the pressure parameter rho in the equilibrium state before snap-through were calculated for various values of the geometric parameter lambda, which is proportional to the angular extent of the imperfection for a given radius-to-thickness ratio, and the imperfection amplitude parameter delta, which is the ratio of the initial deviation of the shell mid-surface at the axis of rotation to the wall-thickness. The results of numerical computations show that for all values of delta the lowest buckling pressure is reached when lambda is about 4.
Author (TAB)

N68-32558 National Lending Library for Science and Technology, Boston Spa (England).
RESULTS OF RECENT RESEARCH INTO CIRCULAR ADHESIVE JOINTS, ESPECIALLY IN VIEW OF TEST PIECES TO BE STANDARDISED
G. Kaliske 4 Jul. 1968 13 p refs Transl. into ENGLISH from Plaste Kautschuk (Leipzig), v. 13, no. 1, 1966 p 26–30
(T6041) Available from Natl. Lending Library, Boston Spa, Engl.

A test piece was developed to examine the resistance of adhesions of glued circular joints to stretching and shearing and the influence of width of the gap, length of overlapping and condition of the joining parts surface. The effect of the test conditions on the adhesive strength and the possibility of regenerating test pieces of different joining part materials were also examined. It was proved by tension and expansion measurements that circular joints show considerable stretch peaks of tension under tensile shearing stresses at the overlapping edges.
Author

N68-32594# California Univ., Berkeley. Structural Engineering Lab.

REFINED FINITE ELEMENT ANALYSIS OF LINEAR AND NONLINEAR TWO-DIMENSIONAL STRUCTURES

Carlos A. Felippa Oct. 1966 233 p refs
(Grant NSF GK-75)
(SESM-66-22; PB-178418) CFSTI: HC$3.00/MF$0.65

The purpose of this report is to study the application of refined displacement finite elements for the direct stiffness analysis of linear and nonlinear problems of structural mechanics. A systematic procedure to construct polynomial displacement fields based on the use of interpolation formulas in natural coordinates is applied to plane triangles of linear elastic material using the first three complete polynomial expansions. Author (USGRDR)

N68-32610# New York Univ., N. Y. Dept. of Aeronautics and Astronautics.

AN APPLICATION OF THE EXTENDED KANTOROVICH METHOD TO EIGENVALUE PROBLEMS

Arnold D. K. Kerr Dec. 1967 25 p refs
(Grant AF-AFOSR-67-0813)
(NYU-AA-67-116; AFOSR-68-0153; AD-671529)

This report deals with the results of a research effort in the area of Automata and Communications. Abstracts of principal papers in the areas of automata theory, error-correction techniques in digital computers, signal design and synchronization problems in digital communication systems, and similar areas are presented. Author (TAB)

N68-32621# Drexel Inst. of Tech., Philadelphia, Pa. Dept. of Metallurgical Engineering.

STRESS STATE IN THE COMBINED STRESS TORSION TEST

H. A. Kuhn May 1968 25 p refs
(Contract N00019-67-C-0251)
(AD-671946)

An analysis of the stresses in the axial stress-torsion test is presented by considering the gage section as a cylinder undergoing uniform axial deformation with superimposed torsion. Calculation of the stresses requires measurement of the radial deformation and penetration of the plastic region into the notch shoulders. The hydrostatic stress exhibits a peak within the wall of the gage section which increases with decreasing gage length. The fracture strain in room temperature tests increases with decreasing gage length when a compressive axial load is applied and decreases slightly with decreasing gage length when a tensile axial load is applied. Severe distortion and large changes in length of the gage section during hot torsion testing prevent application of the analysis to high temperature tests. Author (TAB)

N68-32634# California Univ., La Jolla. Aerospace and Mechanical Engineering Sciences Dept.

THE INFLUENCE OF DAMPING ON THE SNAPPING OF A SHALLOW ARCH UNDER A STEP PRESSURE LOAD

G. A. Hegemier and F. Tzung Apr. 1968 30 p refs
(Grant AF-AFOSR-1226-67)
(TR-9; AFOSR-68-1085; AD-671545)

The snapping of a simply-supported shallow sinusoidal arch under a sinusoidally distributed step pressure load is considered. In the presence of velocity-dependent damping of any nonzero magnitude, it is shown that there exists no difference between static and dynamic snap loads for arch rises above a certain magnitude and for sufficiently small external disturbances. Below the foregoing value of arch rise snapping is governed entirely by symmetric snap-through. The results obtained herein, when compared to an existing analysis on the subject, imply that a jump in the critical snap-through load occurs at the boundary between the damped and undamped systems. Similar results concerning cylinders and rings are mentioned. Author (TAB)

N68-32635# Wisconsin Univ., Madison. Mathematics Research Center.

THE ESTIMATION OF RELIABILITY FROM STRESS-STRENGTH RELATIONSHIPS

J. D. Church and Bernard Harris Dec. 1967 13 p refs
(Contract DA-31-124-ARO(D)-462)
(MRC-TSR-814; AD-671605)

Confidence intervals for P{braces:Y<X} are obtained under the assumptions that X and Y are independently normally distributed and the distribution of Y is known. The procedure of this paper are compared with a procedure suggested by Z. Govindarajulu. Author (TAB)

N68-32764# Dayton Univ., Ohio. Research Inst.

SIMULATION OF HIGH VELOCITY IMPACTS ON THIN TARGETS

H. F. Swift and R. F. Prater Wright-Patterson AFB, Ohio AF Mater. Lab. Apr. 1968 32 p refs
(Contract F33615-68-C-1138)
(UDRI-TR-68-18; AFML-TR-68-88; AD-671522)

Current interest in investigating impacts of thin structural plates by pellets traveling at velocities of 15 km/sec and above has prompted efforts to simulate the process under laboratory conditions. Pellet and plate debris vaporization that results from such impacts cannot be achieved in the laboratory. A partial laboratory simulation of these impacts can be achieved by substituting easily vaporized materials such as cadmium for the structural materials of direct interest. The AFML Impact Physics Group has developed a series of techniques for carrying out such simulations. Besides measurements of gross damage effects, the velocity, mass, and momentum distributions within the simulated debris clouds can be measured as functions of time after impact. A limited number of typical results for cadmium-on-cadmium impacts are presented. Author (TAB)

N68-32755# Lehigh Univ., Bethlehem, Pa. Center for the Application of Mathematics.

THE INTERACTION OF FINITE AMPLITUDE DEFLECTION AND STRETCHING WAVES IN ELASTIC MEMBRANES AND STRINGS

David F. Parker and Eric Varley May 1968 41 p refs
(Contract N00014-67-A-0370)
(CAM-100-2; AD-671840)

Disturbances produced by the motion of a driver which is rigidly bonded to the edge of a plate are used to motivate parameter expansion techniques which when applied to the equations of finite elasticity, generate approximating equations which describe low frequency deflection and stretching waves travelling along stretched elastic plates and rods in the limit when bending forces are negligible compared with membrane forces. The structure of the boundary layer at the driven edge and shock layers, where the low frequency or filament approximations are locally invalid, are also discussed. The low frequency equations are used to discuss the interaction between progressing finite amplitude deflection and stretch waves in the limit when the stretch rate is small compared with the angular speed of the plate. The disturbance is locally that of a pure deflection simple wave whose amplitude and frequency are modulated by slow variations in the stretch. As the stretch increases the frequency increases while the amplitude decreases. The stretch wave is also modified by deflection of the plate: the speeds of wavelets carrying constant values of stretch are always less than their values in the pure stretch simple wave. Author (TAB)

N68-32816# California Univ., Berkeley. Div. of Applied Mechanics.
ON TORSION OF AN ELASTIC CYLINDRICAL COSSERAT SURFACE
M. L. Wenner Jan. 1968 19 p refs
(Contract Nonr-222(69))
(AM-68-2; AD-671767)

Using the linearized theory of an elastic Cosserat surface for an isotropic material, the problem of torsion of a cylindrical Cosserat surface is discussed; the edge curve perpendicular to the generator is not necessarily circular. Torque-twist relationships are obtained for both open and closed surfaces. Author (TAB)

N68-32899# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.
AN INVESTIGATION OF SAINT-VENANT'S PRINCIPLE IN THE SEMI-INFINITE STRIP
Samuel C. W. Ng (M.S. Thesis) Jun. 1968 100 p refs
(GSF/MC/68-7; AD-671999)

A generalized Fourier expansion is employed to obtain a numerical interpretation of Saint-Venants principle. The investigation is made for stress and displacement boundary conditions on an end-loaded semi-infinite elastic strip with a Poisson ratio of 1/3. Continuous and concentrated loads in both symmetric and antisymmetric configurations are considered. Saint-Venants sufficiently far distances are obtained for six specific cases and trends are noted. No attempt is made to study in detail the convergence of the series expansion. A comparison is made between the exact solution and the elementary beam theory solution of the deflection of a fixed-end beam in flexure. Author (TAB)

N68-32912# Lehigh Univ., Bethlehem, Pa. Center for the Application of Mathematics.
GENERALIZED MECHANICS OF CONTINUOUS MEDIA
Ronald S. Rivlin Oct. 1967 33 p refs
(Contract N00014-67-A-0370)
(CAM-100-1; AD-671236)

A continuum-mechanical theory is presented in which the deformation is described by the usual displacement field and a number of other vector fields (director). It is motivated, as to detail, by a particle model and the steps leading from this model to a continuum are carefully traced. Author (TAB)

N68-32931 Princeton Univ., N. J.
MULTIPLE POINTS OF RUPTURE IN TEXTILE FIBERS
Charles Edward Warburton, Jr. (Ph.D. Thesis) 1967 90 p
Available from Univ. Microfilms: HC $4.60/MF $3.00 Order No. 67-13513

Under certain conditions some textile fibers break at more than one point when extended to rupture. The breaks are uniformly distributed along the central portion of the test length with a higher concentration existing at or near the boundaries (i.e., the tabs or jaws). The region of uniform distribution results from initial random breaks while the high concentrations at the ends are due to reflections or energy waves. Strain-wave propagation is proposed as the mechanism which accounts for the occurrence of these multiple breaks. Recoverable energy stored in the fiber during extension is considered to be the driving force for wave propagation. Dissert. Abstr.

N68-32939# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
TOWARD THE DEVELOPMENT OF AN INTEGRAL-EQUATION METHOD APPLICABLE TO SOLUTION OF SHELL-THEORY BOUNDARY-VALUE PROBLEMS [K RAZVITIYU METODA INTEGRAL'NYKH URAVNENIY PRIMENITEL'NO K RESHENIYU KRAYEVYKH ZADACH TEORII OBOLOCHEK]
N. I. Remizova 21 Jul. 1967 10 p refs Transl. into ENGLISH from Tr. Teoriya Plastin i Obolochek (Lvov), no. 2, 1962 p 124–127 Presented at the 2d All-Union Conf., Lvov, 15–21 Sep. 1961
(FTD-HT-67-249; AD-671742)

Previous studies have considered the solution of certain problems in the theory of cylindrical shells by a method worked out by N. A. Kilchevskiy using a system of integrodifferential equations in displacements. In this paper consideration is given to problems which reduce to a solution of a system of integral equations in the forces and moments. A typical problem is presented and solved. TAB

N68-32976*# Fundamental Methods Associates, Inc., New York.
APPLICATION OF DUST FOR SPACE STRUCTURES
Carl N. Klahr, Sylven N. Cutler, and Kalman Kalikstein Washington NASA Aug. 1968 61 p ref
(Contract NASw-1374)
(NASA-CR-1136) CFSTI: HC $3.00/MF $0.65 CSCL 22A

This report is concerned with the physical properties and applications of small particles—particles whose masses range from 100 micrograms to 1 micro-microgram. A dust structure will be defined to be a spatial distribution of discrete particles whose relative geometry is maintained by the particle trajectories or by individual particle motion, and not by conventional cohesive forces which hold solids or liquids together. Therefore, dust configurations can be considered a new type of physical structural material, having properties often unlike those of solids, liquids, or gases. Various means can be used to maintain the cross relative geometry of the spatial distribution which constitutes the dust structure. Dust structures have unique properties across the entire thermal and electromagnetic energy spectrum, from optical frequencies through microwave and radio frequencies. Their inertial and mechanical properties as well as their gross material behavior are also quite unusual. Author

N68-33007# Boeing Scientific Research Labs., Seattle, Wash. Mathematics Research Lab.
THE PRECESSION AND NUTATION OF DEFORMABLE BODIES. 5: EQUATIONS OF MOTION FOR SPHEROIDAL DEFORMATION
Zdenek Kopal May 1968 54 p refs *Its* Mathematical Note No. 558
(D1-82-0721)

The general form of the Eulerian equations for the precession and nutation of deformable bodies were particularized for the case in which the deformation is characterized by spheroidal symmetry. This assumption (which is sufficiently general to embrace most cases of astronomical interest) allows separation of the angular and radial variables in the volume integrals contained as coefficients of the deformation terms in the equations of motion. Since the deformation of self-gravitating viscous or elastic bodies due to axial rotation or tidal attraction of configurations of arbitrary internal structure has already been investigated, their radial integrals involved as coefficients of the equations of motion can be evaluated and the equations themselves solved for the Eulerian time-dependent angles of precession and nutation. The aim was to establish the explicit forms of the respective equations of motion by reducing the volume-integrals to integrals in the radial variable only. Solutions of these equations in the form of periodic time series will be given in the next report. Author

N68-33035*# Polytechnic Inst. of Brooklyn, N. Y. Aerospace Engineering and Applied Mechanics Dept.
NATURAL FREQUENCIES OF ORTHOTROPIC CIRCULAR PLATES OF VARIABLE THICKNESS

Alan P. Selzman and Sharad A. Patel Apr. 1968 29 p refs Sponsored in part by NASA
(Contract NONR-839(40) FBM)
(NASA-CR-96314; PIBAL-68-8; AD-669900) CFSTI: HC $3.00/MF $0.65 CSCL 20K

The present investigation is concerned with the natural frequencies of orthotropic circular plates of variable thickness. In particular, a thickness variation of the form h = h sub o (1-H(R to the nth power)) has been selected. The derivation of the differential equation governing the motion of the plate is based on the classical formulation of the theory of plates. The solution of this equation for the axisymmetric case is obtained by an application of the method of Frobenius. Characteristic equations for the natural frequencies of clamped and simply supported plates are derived and numerical results are presented for several plates of various shapes. Author (TAB)

N68-33057*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
ON THE PREDICTION OF THE VIBRATORY BEHAVIOR OF FREE-FREE TRUNCATED CONICAL SHELLS
Eugene C. Naumann Washington Sep. 1968 34 p refs
(NASA-TN-D-4772) CFSTI: HC $3.00/MF $0.65 CSCL 20K

An analytical procedure is described for the prediction of the frequencies and mode shapes for free-free truncated conical shells. The method utilizes simple power series modal assumptions in a Rayleigh–Ritz type solution procedure. Excellent agreement was obtained when analytical results were compared with experimentally obtained frequencies and meriodional mode shapes. Comparisons between analytical and experimental results are presented for truncated conical shells over the following range of parameters: (1) semivertex angles from 3.4° to 60.5°, (2) shell thicknesses from 0.0178 cm to 0.0813 cm, (3) shell truncation ratio (minimum radius/maximum radius) from 1/8 to 6/7, (4) shell maximum radius from 15.43 cm to 60.96 cm, and (5) materials—aluminum alloy, cold rolled steel, and stainless steel. Author

N68-33092*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
A MATRIX METHOD FOR STUDYING MOTIONS OF SPACECRAFT CONSISTING OF INTERCONNECTED RIGID BODIES
Richard E. Turner Washington Sep. 1968 47 p refs
(NASA-TN-D-4749) CFSTI: HC $3.00/MF $0.65 CSCL 20K

A system of matrix equations was developed which describes the interaction between two rigid bodies joined at a point. The relative motion of the bodies is treated by projection matrices. A projection matrix is found which determines the angular acceleration allowed by relative angular motion about a common attachment point. Another projection matrix is found which determines the components of relative angular acceleration of the two bodies caused by physical constraints on their relative angular motion. By using these matrices, an automatically applied. This equation, the translational momentum equation, the angular momentum equation, and the translational constraint equation form a set of equations which can be used to add rigid rotating bodies to a dynamical system to achieve a new dynamical system of any desired complexity. This method is useful when constraint forces and torques must be calculated. An example dynamical system which consists of a central hub with four rigid wings connected to the hub at four different attachment points is studied. The equations of motion for this system were integrated numerically, and some parameters which describe the motion of the system are presented graphically. Author

N68-33095# Joint Publications Research Service, Washington D. C.
STRENGTH AND PLASTICITY OF WELD JOINTS OPERATING IN CONTACT WITH LIQUID LITHIUM
Ya. K. Bebkovich, V. F. Shatinskiy, and M. I. Chayevskiy 22 Aug. 1968 20 p refs Transl. into ENGLISH from Fiz.-Khim. Mekhan. Materialov. Akad. Nauk Ukr. SSR (Kiev), v. 4, no. 1, 1968 p 3-21
(JPRS-46254) CFSTI: HC $3.00/MF $0.65

Results are cited for short term and lengthy tensile tests on welded samples of 1Cr18Ni10Ti and 2Cr13 steels in fused lithium. The effect of a lithium melt on weld joints as a function of the purity of the welded seam with regard to gaseous impurities is considered. Author

N68-33120# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
THE DISTRIBUTION OF SLIP LINE DIRECTION IN PLASTIC DEFORMATION [O RASPREDELENII NAPRAVLENIY LINIY SDVIGA PRI PLASTICHESKOM DEFORMIROVANII]
A. M. Lokoshchenko and S. A. Shesterikov *In its* Moscow Univ. Herald. Ser. 1: Math., Mech., No. 2, 1964 6 Jun. 1967 p 47-50 ref (See N68-33115 20-19)

The slip line direction distribution on the ground end plane of a specimen was solved with the assumption that the possible slip planes are arranged with equal probability relative to the maximum shear stress. The solution is given on the basis of representing a real material by a set of elements with ideal properties. Furthermore, it is assumed that the normal vector to the possible slip plane can make an angle with the applied stress between $\pi/4-\delta$ and $\pi/4+\delta$, $0 \leq \delta \leq \pi/4$, with equal probability. On this basis, an expression is derived for the distribution of slip line directions at the ground end plane. Author

N68-33125# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
AN APPROXIMATE METHOD OF THE DETERMINATION OF THE AVERAGE DIAMETER OF A HOLE FORMED IN A BARRIER MADE BY A STRIKER AT HIGH IMPACT SPEED [PRIBLIZHENNY METOD OPREDELENIYA SREDNEGO DIAMETRA OTVERSTIYA, OBRAZOVANNOGO V PREGRADE BOYKOM PRI BOL'SHIKH SKOROSTYAKH SOUDARENIY]
A. Ya. Sagomonyan and V. S. Kutlyarov *In its* Moscow Univ. Herald. Ser. 1: Math., Mech., No. 2, 1964 6 Jun. 1967 p 75-82 refs (See N68-33115 20-19)

The paper examines the widening of a cylindrical hole in a metal carrier under the action of great pressure that is relieved suddenly at a certain instant of time. Behind the shock wave the metal is assumed to behave as a perfectly plastic body. Author

N68-33140 Lehigh Univ., Bethlehem, Pa.
STRESS SINGULARITIES IN THE BENDING OF COSSERAT PLATES
Nicholas Joseph Pagano (Ph.D. Thesis) 1967 114 p
Available from Univ. Microfilms: HC $5.60/MF $3.00 Order No. 67-14948

The influence of couple-stresses in plate bending is studied by application of a recent theory developed by Green and Naghdi which is based upon the concept of an oriented body, or Cosserat plate. A complete derivation of the linear bending theory of an elastic Cosserat plate under static loading is presented, including a study of the natural boundary conditions and uniqueness theorems for continuous and concentrated loads. The exact relationship of the present theory to the Reissner and classical plate bending theories is pointed out. The method of Fourier transforms is utilized to solve a number of problems in the bending of Cosserat plates in which stress singularities are present. In the problems concerning concentrated loads acting on the free edge of a semi-infinite plate, it is shown that the singularities in the shear and moment resultants are generally of the same order as those given in Reissner's theory while the detailed structures of the functions describing the local stress distribution are modified. Dissert. Abstr.

N68-33153 Polytechnic Inst. of Brooklyn, N. Y.
CREEP STRESS CONCENTRATION AT A CIRCULAR HOLE IN AN INFINITE PLATE
Michael Robert Birnbaum (Ph.D. Thesis) 1967 60 p
Available from Univ. Microfilms: HC $3.00/MF $3.00 Order No. 67-13381

The problem of creep stress concentration at a small circular hole in an infinite thin plate subjected to uniaxial tension is analyzed in the first part of the dissertation. The second part is essentially an extension of the preceding analysis to the case when the loading is biaxial and consists of tension and compression. These analyses are based on a creep power law and an analogy between the problem of creep and the corresponding nonlinear elastic problem. The solution of this problem is based on Galerkin's method. The stress solutions for some values of the index of the power law are presented. Dissert. Abstr.

N68-33156# New Mexico Univ., Albuquerque. Bureau of Engineering Research.
STRESS FIELD IN THE VICINITY OF AN IRWIN-CRACK
Frederick D. Ju and Alfred Arcache Feb. 1968 95 p refs
(Grant AF-AFOSR-568-66)
(ME-33; AFOSR-68-0891; AD-671916)

The purpose of this investigation was to apply the logarithmic hypothesis of the plane elastic dislocation theory to approximate a plane fracture problem. The region of study is essentially elastic except for a very small region in the neighborhood of the crack which is at some undefined plastic state. The model is a large, thin plate, tensile specimen bounded at the interior by a circular hole from which two stable natural cracks are originated. Author (TAB)

N68-33168*# Southampton Univ. (England).
THE RESPONSE OF A SIMPLY SUPPORTED PLATE TO TRANSIENT FORCES. PART 2: THE EFFECT OF N-WAVES AT OBLIQUE INCIDENCE
Anthony Craggs Washington NASA Sep. 1968 25 p refs
(Grant NGR-52-052-003)
(NASA-CR-1176) CFSTI: HC $3.00/MF $0.65 CSCL 20K

A numerical method is used to compute the response of a simply supported plate to an 'N' wave arriving at oblique incidence. The factors influencing the response under these conditions are: (1) the ratio of the pulse duration to the fundamental period of the plate and (2) the convection forcing terms which are different for each mode. Also, asymmetric modes are excited, which do not make any contribution when the wave is at normal incidence to the plate. The computed results show that both the convection terms and the asymmetrical modes make a significant contribution to the form of the response for the displacements, velocities, and accelerations, though their effects are more dominant in the accelerations than for any other parameter. Author

N68-33191*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
EFFECT OF RESIDUAL STRESS ON FRACTURE STRENGTH OF AISI 301 STAINLESS-STEEL AND Ti-6Al-2.5Sn ELI TITANIUM CRACKED THIN WALL CYLINDERS
Frederick D. Calfo Washington Sep. 1968 27 p refs
(NASA-TN-D-4777) CFSTI: HC $3.00/MF $0.65 CSCL 20K

Six-inch- (15.2-cm-) diameter cylinders containing through-cracks were fabricated from 0.020-inch- (0.051-cm-) thick Ti-6Al-2.5Sn ELI titanium and 0.022-inch(0.056-cm-) thick AISI 301 stainless steel. Stress-relieved and non-stress-relieved cylinders were pressurized to burst at −423° and −320°F (20° and 77°K). The residual banding stresses in the titanium alloy were reduced from 65,000 to 6000 psi (45,000 to 4000 N/cm^2) by means of a stress-relieving heat treatment. The effect was an increase in fracture strength of about 10,000 to 15,000 psi (6900 to 10,400 N/cm^2). A reduction of residual stresses from 60,000 to 30,000 psi (42,000 to 21,000 N/cm^2) in the stainless-steel cylinders did not appreciably change their fracture strength. Author

N68-33213*# McGill Univ., Montreal (Quebec). Space Research Inst.
ONE-DIMENSIONAL ANALYSIS OF THE HYPERVELOCITY IMPACT OF A PELLET ONTO A THIN BUMPER
P. S. Gough Nov. 1967 90 p refs
(Contract NAS3-10299)
(NASA-CR-54725; SRI-TN-8) CFSTI: HC $3.00/MF $0.65 CSCL 20K

A one-dimensional hydrodynamic formulation of the hypervelocity impact of a pellet onto a thin bumper is analyzed by finite difference techniques. A first order scheme due to Lelevier is used with the artificial viscosity due to Von Neumann and Richtmyer. A perfect gas equation of state is assumed, and results for the complete interaction, including the secondary surface effect, are presented. The finite difference code remained computationally stable during the study. However, the long term expansion results are not within the realm of the physical assumption of one-dimensionality. Consequently, the long term stability is more important mathematically than physically. A useful feature of the work is the elimination of small local disturbances, or "jitters". A new technique of smoothing was successfully employed. Author

N68-33225*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
FREE VIBRATION OF A ROTATING BEAM-CONNECTED SPACE STATION
James La Mar Milner Washington Sep. 1968 99 p refs
(NASA-TN-D-4753) CFSTI: HC $3.00/MF $0.65 CSCL 20K

The free vibration of a rotating beam-connected space station is analyzed with a mathematical model of the space station which represents the general three-dimensional motion of the various components of the system. The space station is composed of two space modules connected by flexible beam, and the system is caused to spin in the plane of its orbit in order to produce an artificial gravity environment within the space modules. The kinetic energy and potential energy of the space station are used to develop a Lagrangian function of the system. Hamilton's principle is used to determine a set of governing equations, and a set of boundary conditions representing a clamped-clamped attachment of the beam to each space module is applied to the ends of the beam. Within the limits of small deflection theory, the motion of the space station is shown to be uncoupled into two separate types of motion, one in the plane of rotation and the other perpendicular to the plane of rotation. An exact solution is obtained for the beam deflection in the plane of rotation. The application of the nonhomogeneous boundary conditions leads to a set of simultaneous equations in the frequency p^2, from which a characteristic determinant is developed. A procedure to solve for the zeros of the characteristic determinant is programmed for digital solution on the IBM 7094. Author

N68-33228*# California Inst. of Tech., Pasadena.
THE BUCKLING OF THIN-WALLED CIRCULAR CYLINDERS UNDER AXIAL COMPRESSION AND BENDING
F. R. Stuart, J. T. Goto, and E. E. Sechler Washington NASA Sep. 1968 48 p refs
(Grant NsG-18-59)
(NASA-CR-1160) CFSTI: HC $3.00/MF $0.65 CSCL 20K

A series of tests was conducted on both electroplated copper and Mylar cylinders under combined axial compression and bending. Great care was taken to assure that the cylinders were as perfect as was possible and loading and boundary conditions were carefully controlled. For the Mylar cylinders, corrections were made

for both area and stiffness of the lap joint. Under these conditions, much higher values of the buckling stress were obtained than had been reported on by previous investigators. Author

N68-33262# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
STABILITY AND NATURAL VIBRATIONS OF TRUNCATED STRUCTURALLY-ORTHOTROPIC CONICAL SHELLS [USTOYCHIVOST' I SOBSTVENNYYE KOLEBANIYA USECHENNYKH KONSTRUKTIVNO-ORTOTROPNYKH KONICHESKIKH OBOLOCHEK]
V. F. Natushkin and A. N. Kirichenko *In its* News of Inst. of Higher Learning. Aeron. Eng., no. 1, 1966 2 Oct. 1967 p 1-9 refs (See N68-33261 20-23)

Determination of eigenvalues of closed shells of revolution with degenerated poles and variable rigidity and geometric parameters turned out to be reducible to a single mathematical algorithm $\nu = \nu_0\eta$, where ν — desired eigenvalue, ν_0 — eigenvalue of a certain similar shell with constant parameters. For a conical shell, such a similar shell would be a cylinder whose radius is equal to the average radius of curvature, height — length of generatrix, and thickness — mean thickness of initial surface. It follows that the problem of finding the desired searched eigenvalue consists of a basic and an additional problem. The basic problem is finding the solution of an equation with constant coefficients, which determines ν_0. The additional problem is connected with finding the coefficient of influence of variability of shell parameter η. Author

N68-33266*# North Carolina State Coll., Raleigh.
NOISE REDUCTION SHAPE FACTORS IN THE LOW FREQUENCY RANGE
J. Ronald Bailey and Franklin D. Hart Washington NASA Sep. 1968 52 p refs
(Grant NGR-34-002-035)
(NASA-CR-1155) CFSTI: HC $3.00/MF $0.65 CSCL 20A

An analysis is made of noise reduction of small enclosures in the low-frequency range where both panel and volume are stiffness controlled. The strong dependence on geometry of the compliance of flexible panels is illustrated. Shape factors for low-frequency noise reduction are established through expressions for the acoustic compliance of enclosures and the compliances of rectangular, circular, cylindrical, and spherical panels. A comparison is made of the noise reduction of enclosures involving these elements and having equal volume, panel thickness, and exposed surface area. It is observed that the stiffer, membrane-controlled spherical and cylindrical enclosures have greater noise reduction than enclosures having flexure-controlled flat panels. A companion experimental investigation is described and the results are discussed and compared with the theory. Author

N68-33294# Wisconsin Univ., Madison. Mathematics Research Center.
BUCKLING OF COMPOSITE CYLINDRICAL SHELLS UNDER PURE BENDING
A. C. Ugural and S. Cheng Jan. 1968 35 p refs
(Contract DA-31-124-ARO(D)-462)
(MRC-TSR-837; AD-671607)

An analysis is presented for solving the buckling problems of laminated long cylindrical shells under pure bending. An effective iteration scheme has been employed so that numerical computations to yield the critical bond parameters can be easily performed. Author (TAB)

N68-33326# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ENGINEERING JOURNAL, VOLUME 1, NO. 2, 1961 (SELECTED ARTICLES)
29 Jun. 1967 36 p refs Transl. into ENGLISH from Inzh. Zh. (Moscow), v. 1, no. 2, 1961 p 97-111
(FTD-HT-66-648; AD-670111)

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2. NATURAL OSCILLATIONS OF PRISMATIC SHELLS OF THE MONOCOQUE-TYPE AIRPLANE WING IN A SUPERSONIC AIR FLOW A. I. Yelpat'yevskiy p 19-31 refs (See N68-33328 20-32)

N68-33327# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
FORCED OSCILLATIONS OF PLATES WITH A LOAD REPRESENTING A SPACE-TIME PROCESS [VYNUZHDENNYYE KOLEBANIYA PLASTIN PRI NAGRUZKE, PREDSTAVLYAYUSHCHEY ZOBOY PROSTRANSTVENNO-VREMENNOY SLUCHAYNYY PROTSESS]
M. F. Dimentberg *In its* Eng. J., Vol. 1, No. 2, 1961 29 Jun. 1967 p 1-18 refs (See N68-33326 20-32)

The question of the oscillations of thin-walled elements with the action of random loads in connection with acoustic fatigue in the construction of modern flying apparatuses is discussed. The question of forced oscillations of a rectangular plate with a load constituted by a random function of time and space is considered. The natural frequencies are determined in accordance with the asymptotic method. As natural functions there are used functions precisely satisfying a differential equation; the boundary conditions are fulfilled with precision up to asymptotic error. The problem of stresses in vibration of a fastened plate under the action of plane acoustic waves of random frequency and amplitude is considered in detail. Author

N68-33328# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
NATURAL OSCILLATIONS OF PRISMATIC SHELLS OF THE MONOCOQUE-TYPE AIRPLANE WING IN A SUPERSONIC AIR FLOW [AVTOKOLEBANIYA PRIZMATICHESKIKH OBOLOCHEK TIPA KESSONA KRYLA SAMOLETA V SVERKHZVUKOVOM POTOKE VOZDUKHA]
A. I. Yelpat'yevskiy *In its* Eng. J., Vol. 1, No. 2, 1961 29 Jun. 1967 p 19-31 refs (See N68-33326 20-32)

The process of oscillations of prismatic shells with undeformed contour, taking into account the skewing of the sections on the basis of a variation method in displacements, is described by a system of equations. Author

N68-33349 National Lending Library for Science and Technology, Boston Spa (England).
THE MECHANICAL PROPERTIES OF BURSTING DISCS UNDER LONG-TIME SERVICE EXPOSURE [DAS FESTIGKEITSVERHALTEN VON BERSTSCHEIBEN BEI LANGZEITIGER BEANSPRUCHUNG]
H. Keller 29 Jul. 1968 10 p refs Transl. into ENGLISH from Werkstoffe Korrosion (Weinheim/Bergstrasse), v. 19, 1968 p 200-204 In ENGLISH and GERMAN *Its* Transl. 68/141
Available from Natl. Lending Library, Boston Spa, Engl.

The creep response of ductile and brittle bursting disc materials was studied in an attempt to establish (1) the accuracy of response (i.e., tolerance to response pressures of pressure vessels), and (2) durability under normal service pressure conditions. To establish scatter band limits of bursting pressure as a function of foil holding device (clamping), long and short term tests were made on flat bursting discs consisting of 0.8 mm thick and 100 mm nominal diameter aluminum sheet. Clamping resulted

in an edge radius of 0.2mm and 2mm. Short term tests revealed that with a small edge radius the bursting disc cracks because of the notch effect at the edge; however, with larger edge radii, the notch effect is significantly lower and the discs burst in the center. Long term tests indicated that although the creep strength of the larger edge radius of the support was higher, the desired improvement was not attained. Creep strength properties of pure nickel bursting discs were studied under condition of high uniaxial stress (stationary), and under non-stationary stress conditions. It was found that under stationary stress conditions and an operating pressure of approximately 85% of the permissable container pressure, bursting discs in nickel offer sufficient reliability against unexpected failure for at least a year. Alternating load tests (90% and 83% of bursting pressure and 1 atm) on nickel bursting discs with a vacuum support showed that the proposed design did not guarantee the desired long service with full reliability. Studies on graphite impregnated with synthetic resin are cited which demonstrate the advantages of using brittle materials for bursting discs as opposed to metals which are ductile at the service temperatures. S.C.W.

N68-33360# California Inst. of Tech., Padasena. Div. of Engineering and Applied Science.
PULSE PROPAGATION IN AN ELASTIC PLATE WITH A BUILT-IN EDGE
Julius Miklowitz May 1968 41 p refs
(Contract Nonr-220(57))
(TR-7; AD-671876)

In a recent report the author presented a method for treating waveguide problems based on the equations of motion from linear elasticity theory, and involving non-mixed edge conditions (the stresses or the displacements). In the method a Laplace transform, say parameter s, is used on the propagation coordinate, say x. To insure that a solution be bounded as x approaches infinity, residues at the poles of the transformed solution in the right half s-plane, and corresponding to complex wave number roots of the governing Rayleigh-Lamb frequency equation, are set equal to zero. This generates two coupled integral equations for the edge unknowns which depend, parametrically, on these complex wave number roots. Solution of these equations determines the transformed solution of the problem, which can be inverted through known techniques. In the present work this general method is used to solve the problem of a semi-infinite plate with a built-in edge, excited by suddenly applied symmetric normal line loads on its faces, and near the edge. The long time solution, for the near and far field is obtained, disclosing the nature of the reflection process at the edge. Interesting is the fact that the edge generates a pulse that in the far field is non-decaying in space and time, having the same form found in analogous dynamic edge (or end) load problems. Author (TAB)

N68-33391# Boeing Scientific Research Labs., Seattle, Wash. Mathematics Research Lab.
ESTIMATION FOR A FAMILY OF LIFE DISTRIBUTIONS WITH APPLICATIONS TO FATIGUE
Sam C. Saunders (Wash. Univ., Seattle) and Z. W. Birnbaum (Wash. Univ., Seattle) Mar. 1968 32 p refs *Its* Math. Note 561
(D1-82-0724; AD-671968)

The estimation problem is studied for a new two-parameter family of life length distributions which has been previously derived from a model of fatigue crack growth. Maximum likelihood estimates of both parameters are obtained and iterative computing procedures are given and examined. A simple estimate of the median life is exhibited, shown to be consistent and then compared, favorably, with the maximum likelihood estimate. More importantly the asymptotic distribution of this estimate is shown to be within the same class of distributions as the observations themselves. This model, and these estimation procedures, are tried by fitting this distribution to several extensive sets of fatigue data and then some comparisons of practical significance are made. Author (TAB)

N68-33419*# California Inst. of Tech., Pasadena.
ALMOST SURE STABILITY OF LONG CYLINDRICAL SHELLS WITH RANDOM IMPERFECTIONS
Rena Scher Fersht Washington NASA Aug. 1968 24 p refs
(Grant NsG-18-59)
(NASA-CR-1161) CFSTI: HC$3.00/MF$0.65 CSCL 20K

A Lyapunov method is used to obtain sufficient conditions for the buckling stability of cylindrical shells with axisymmetric random imperfections. A perturbed system of equations in the neighborhood of the prebuckling solution is investigated. By reducing the problem to a system of integral equations, the stability boundary value problem of a long shell is similar to that of a dynamical system with random parametric excitations. The method has been tested numerically for the case of axisymmetric random imperfections of a cylindrical shell under axial compression. Initial imperfections were assumed to have Gaussian distribution and an exponential cosine correlation function. The critical load was obtained as a function of the root mean square of the imperfections. Author

N68-33507 National Lending Library for Science and Technology, Boston Spa (England).
ON POSTULATES OF PLASTICITY [O POSTULATAKH PLASTICHNOSTI]
V. I. Malyi Jul. 1968 8 p refs Transl. into ENGLISH from Mekhan. Tverd. Tela, no. 4, 1966 p 65–69
(RTS-4707) Available from Natl. Lending Library, Boston Spa, Engl.: 12s 6d

Change in deformation during a closed cycle under strain is used as the basis for some postulates on plasticity; and some tensors in the six-order vector field are presented according to plastic flow theory. A postulate is formulated for the case of any arbitrary loading, and equations are given for the increase in plastic deformation and the possible bending of the cross section of the stressed surface connected with the changing speed of the elastic properties. The changing speed of the Hooke matrix is limited by the type of flow surface. M.W.R.

N68-33523*# Bellcomm, Inc., Washington, D. C.
REPRESENTATION OF THE TRANSFER FUNCTIONS OF GIVEN STRUCTURES BY THEIR EIGEN-VIBRATIONS, TAKING INTO CONSIDERATION ANY ARBITRARY EXCITATION [DARSTELLUNG DER UBERTRAGUNGSFUNKTEIONEN VORGEGEBNER KONSTRUKTIONEN DURCH DEREN EIGENSCHWINGUNGEN MIT BERUCKSICHTIGUNG BELIEBER ERREGUNGEN]
Jurgen Wolfgang Schindelin [1968] 13 p refs Transl. into ENGLISH from VDI Z. (West Germany), v. 110, no. 8, 1968 p 307–310
(Contract NASw-417)
(NASA-CR-98318) CFSTI: HC$3.00/MF$0.65 CSCL 20K

The dynamic behavior of given designs or structures can be described by a system of differential equations. The solution obtained consists in sums of integral terms that can be developed for the eigen-vibrations of the structure. In that way, it becomes possible to derive the transfer functions of the structural elements and to examine their dynamic behavior as dependent on any (arbitrary) excitation functions, by means of the methods commonly used in control technology. Author

N68-33586 Texas Univ., Austin.
DEFLECTION AND VIBRATION CHARACTERISTICS OF ROTATING SYSTEMS SUPPORTED BY ROLLING ELEMENT BEARINGS
John William Bedenbender (Ph.D. Thesis) 1967 195 p
Available from Univ. Microfilms: HC $8.80/MF $3.00 Order No. 67-14797

A procedure is developed to allow systematic computation of deflections and critical speeds in composite shaft-bearing systems. Deflections are obtained for a flexible, nonuniform shaft supported by an arbitrary number of rolling element bearings. Loading may be general, including a thrust load applied at any point along the shaft. Support elasticity, which may be nonlinear, is included and real bearing elasticity is incorporated by employing known force-deflection relationships for rolling element bearings. Equations governing shaft deflections and support reactions are developed in matrix form by applying the beam element method in conjunction with the bearing and support relationships. Digital computer programs are written and used to solve these equations numerically by applying Newton-Raphson iteration. Dissert. Abstr.

N68-33598# National Research Council of Canada, Ottawa (Ontario).
STRESS INTENSITY FACTORS FOR A CRACK PROGRESSING ALONG A SERIES OF EQUALLY SPACED HOLES
P. Huculak (Natl. Aeron. Estab.) Jan. 1968 21 p refs
(NRC-10120; MS-117) CFSTI: HC $3.00/MF $0.65

Theoretical and experimental studies are carried out for the determination of stress intensity factors for the configuration of a crack progressing along a series of equally spaced collinear slits and holes, respectively. The analysis involves the use of a Westergaard stress function in obtaining the stress intensity factor between successive slits. An experimental compliance technique is described for the configuration containing a central crack and nine collinear holes in 2024-T3 sheet specimens subjected to uniaxial tension. Results from the two phases are then compared. Author

N68-33599# United Kingdom Atomic Energy Authority, Risley (England). Authority Health and Safety Branch.
THE EFFECT OF MATERIAL PROPERTIES AND COMPONENT GEOMETRY ON FRACTURE BEHAVIOUR
A. Quirk 1968 53 p refs
(AHSB(S)-R-149) CFSTI: HC $3.00/MF $0.65

It has been shown, previously, that an equation based on a maximum stress failure criterion was compatible with published fast fracture data obtained from tests on pressure components containing through thickness defects. This report shows the dependence of this equation on material yield stress and Charpy V notch energy, and also on the geometry of the components: that is, diameter and thickness. The equation is used to predict the failure stresses of a number of examples taken from the literature. These calculated failure stresses are in good agreement with the published experimental result. Author

33 THERMODYNAMICS AND COMBUSTION

Includes ablation, cooling, heating, heat transfer, thermal balance, and other thermal effects; and combustion theory. For related information see also: 12 Fluid Mechanics; and 27 Propellants.

N68-32237 California Univ., Berkeley.
AN EXPERIMENTAL AND THEORETICAL INVESTIGATION OF THE STEADY-STATE DEFLAGRATION OF SINGLE CRYSTALS OF AMMONIUM PERCHLORATE
Victor Solomon Englaman (Ph.D. Thesis) 1967 182 p
Available from Univ. Microfilms: HC $7.60/MF $3.00 Order No. 67-11616

The objective of this work is to gain further insight into the physical and chemical processes occurring during the deflagration of ammonium perchlorate. To minimize the complicating factors it is desirable to study a system that is as simple as possible geometrically. Accordingly single crystals of ammonium perchlorate are used. Burning rates and ignition delays of single crystals are studied over a range of pressures between 40–140 atm at 26°C. These data were compared with similar studies made on pelletized ammonium perchlorate, in the "as received" and in the recrystallized form. Burning rates increase with increasing pressure and ignition delays decrease with increasing ignition gas temperature. Single crystals burn at a rate 25% higher than that of pressed pellets. A theoretical model is developed to explain the adiabatic combustion of ammonium perchlorate by the application of laminar flame theory to a steady-state, one-dimensional system. Dissert. Abstr.

N68-32242 Rice Univ., Houston, Tex.
HIGH TEMPERATURE THERMODYNAMIC PROPERTIES OF RARE EARTH FLUORIDES
Asim Kumar Chaudhuri (Ph.D. Thesis) 1967 109 p
Available from Univ. Microfilms: HC $5.40/MF $3.00 Order No. 67-13060

High temperature enthalpies of the trifluorides of Ce, Pr, Nd, Gd, Dy and Yb have been determined by drop calorimetry. Encapsulated specimens were heated in a resistance-wound furnace and then dropped into the copper block calorimeter. The temperature of the furnace was measured by a Pt vs Pt–10% Rh thermocouple, while the temperature rise of the calorimeter was followed by a quartz thermometer. A description of various parts of the calorimeter is given, and errors and problems that may arise in such measurements are also discussed. The experimental data on these compounds are fitted to the standard equations and high temperature thermodynamic functions are derived. The enthalpy of uranium monophosphide was measured in a tantalum container, which was dropped into a copper block calorimeter. Dissert. Abstr.

N68-32319 Alabama Univ., University.
OSCILLATORY HEAT TRANSFER
Billy Huse Thrasher (Ph.D. Thesis) 1967 95 p
Available from Univ. Microfilms: HC $4.80/MF $3.00 Order No. 67-13254

A study is made of the published works in fields closely related to that of oscillatory heat transfer. Wire oscillations induced by an alternating current are described and governing differential equations presented. A procedure is established by which the average heat transfer coefficient for an oscillating wire can be determined by measuring the phase angle between the wire current and temperature. The experimental procedure is described by which the instantaneous wire temperature and velocity are measured by using photoelectric cells. Procedured for calibrating the photocells are also described. The oscillatory heat transfer is analyzed graphically by means of graphs of dimensionless parameters. Experimental data are presented for wires of 0.0031 in. and 0.008 in. diameters oscillating in the vertical and horizontal planes with peak to peak amplitudes up to 1-1/4 in. for a frequency range of 20 to 40 Hz. No significant difference is noted in the heat transfer for oscillations in the vertical and horizontal planes. The point of departure from free convection to forced convection heat transfer is clearly shown by the data. Dissert. Abstr.

N68-32330 Kansas State Univ., Manhattan.
BOILING HEAT TRANSFER FROM AN OSCILLATING SPHERE WITH A CRYOGENIC FLUID AT ATMOSPHERIC PRESSURE AND STANDARD GRAVITY
Lyle Gordon Rhea (Ph.D. Thesis) 1967 131 p
Available from Univ. Microfilms: HC $6.40/MF $3.00 Order No. 67-13962

An experimental investigation has been undertaken to determine the effect of oscillation of the heat transfer surface on turbulent film boiling heat transfer and on the lower region of nucleate boiling heat transfer. A transient technique was used to calculate the heat flux from copper sphers of 1-inch, 3/4-inch and 1/2-inch diameter. A steady-state spherical aluminum heater was constructed in order to obtain the nucleate boiling results. In all tests, saturated liquid nitrogen at atmospheric pressure was used as the boiling fluid. The data obtained in the nucleate boiling region showed that the oscillations of the sphere shifted the nucleate boiling curve to the left; i.e., for a given heat flux, the temperature difference decreased. The data obtained in the film boiling tests were found to be in good agreement with theory at zero frequency. The range of frequencies studied was from zero to approximately 12 cps at amplitude-to-diameter ratios of 1.00, 1.34, 2.00, 2.67 and 4.00. It was determined that oscillation of the heat transfer surface considerably increases the heat flux for a given temperature difference over that for natural convection film boiling. The results were correlated with a maximum deviation of +35 percent. Tests were conducted on a corroded surface, a glass-bead-deened surface and a teflon coated surface. The results indicated that a peened surface is comparable to a polished surface.
Dissert. Abstr.

N68-32341 Rutgers Univ., New Brunswick, N. J.
A THEORETICAL STUDY OF THE EFFECT OF CONVECTION ON IGNITION AND COMBUSTION OF LIQUID FUEL DROPLETS
Pu-sen Yeh (Ph.D. Thesis) 1967 109 p
Available from Univ. Microfilms: HC $5.40/MF $3.00 Order No. 67-14772

For the problem of steady or quasi-steady combustion of a spherical fuel droplet in a uniform stream at low Reynolds number, the governing differential equations for mass concentrations and temperature variation including a finite reaction rate, which are coupled with the momentum equation, were solved by the method of inner and outer expansion. The differential equations were linearized by introducing the "modified flame surface" theory, i.e., substituting the reaction term by a Dirac-delta function centered at the flame surface, so that reaction is allowed to occur at a finite rate but is confined to an infinitely thin region. From the results of combustion study, further results were obtained for the ignition and extinction problem by adopting the classical theory of Frank-Kamenetski. This theory states that the ignition process is a transition from a low temperature of kinetically controlled reaction phenomenon to a high temperature or diffusionsly controlled reaction phenomenon. The extinction process is the reverse of the ignition process.
Dissert. Abstr.

N68-32379# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
BURNING OF HETEROGENEOUS CONDENSED SYSTEMS
N. N. Bakhman and A. Belyaev 19 Jan. 1968 226 p refs Transl. into ENGLISH from the Russian Report (FTD-MT-24-315-67; AD-671871)

Contents: Laminar flame in homogeneous gas mixtures; Burning of volatile explosive substances; Laminar diffusion flame during burning of gas or combustion liquid; Burning of solid particles and liquid drops; Burning at the expense of reaction in condensed phase; Speed of mixing of fuel and oxidizer; Certain regularities of transfer of particles and drops by gas flow; Kinetic and diffusion conditions of burning certain expressions for burning rate; Multidimensional burning behavior of condensed mixtures; Multistageness of burning of condensed mixtures; Influence of condensed residue on dependence of burning rate on pressure; Types of condensed mixtures; Dependence of speed of burning on dispersiveness of components; Dependence of speed of burning on ratio of components; Dependence of burning rate on pressure; Dependence of burning rate on initial temperature; Influence of catalytical additions; Burning in systems consisting of flat or cylindrical layers of fuel and oxidizer; Burning of ammonium perchlorate; Burning of powder. TAB

N68-32387# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
EFFECT OF MIXTURE FORMATION ON THE COMBUSTION PROCESS OF GASEOUS FUEL IN A HIGH SPEED STREAM [VLIYANIYE SMESEOBRAZOVANIYA NA PROTSESS VYGORANIYA GAZOOBRAZNOGO TOPLIVA V VYSOKOSKOROSTNOM POTOKE]
V. M. Ivanov, A. M. Alekseyev, and L. A. Volnyanskaya 8 Sep. 1967 16 p refs Transl. into ENGLISH from Novyye Metody Szhiganiya Toppiv i Vopr. Teorii Goreniya (USSR), 1965 p 95–105 (FTD-HT-23-509-67; AD-671586)

When organizing the combustion process in a high speed stream (M approx. = 1) mixture formation plays a substantial role. In preliminarily mixed systems, the burn up of combustion components behind the critical section is more intensive than in unblended. When passing through the critical section the mixture of reaction components, and consequently, their depletion (burn up) are not increased.
Author (TAB)

N68-32401# College of Aeronautics, Cranfield (England).
SUPERSONIC COMBUSTION STUDIES. 2: EXPONENTIAL RELATIONSHIPS BETWEEN PRESSURE, AREA AND PROCESS LENGTH, FOR HEAT ADDITION IN A NON-CONSTANT-AREA DUCT
Paul Flanagan and Roy A. Cookson Mar. 1968 20 p refs (COA-AERO-204) CFSTI: HC $3.00/MF $0.65

Research into the injection and combustion of gaseous fuels in a supersonic flow of high enthalpy air, flowing in a non-constant area duct, has indicated the need for an analytical description of the processes involved. The pressure–area relationship proposed by Crocco for heat addition in a duct has been discussed in this report and gas dynamic equations which utilize this relationship have been derived. Because of the need to include process length in the analysis, an exponential relationship between pressure, area, and length has been proposed and gas dynamic equations based upon this concept have been established. These equations have been used to calculate stagnation and static pressure and temperature ratios for an inlet Mach number of 2 and a value for γ of 1.32.
Author

N68-32571 National Lending Library for Science and Technology, Boston Spa (England).
INVESTIGATIONS OF THE EXPLOSION PRESSURES OCCURRING IN FLAMEPROOF ENCLOSURES, WHEN THE EXPLOSIVE MIXTURES ARE IGNITED BY HIGH-POWER ARCS. RESISTANCE OF THE ENCLOSURES TO IGNITION BY PROJECTED PARTICLES IN THE PRESENCE OF HYDROGEN/AND ACETYLENE/AIR MIXTURES [UNTERSUCHUNGEN UEBER DIE IN DRUCKFEST GEKAPSELTEN GEHAEUSEN AUFTRETENDEN EXPLOSIONSDRUECKE BEI ZUENDUNG EXPLOSIBLER GEMISCHE DURCH LICHTBOEGEN HOHER LEISTUNG SOWIE UEBER DIE PARTIKELZUENDDURCHSCHLAGSICHERHEIT DER GEHAEUSE BEI WASSERSTOFF/UND AZETYLEN/LUFT GEMISCHEN]

W. Fischer
[1967] 23 p refs Transl. into ENGLISH from German Presented at the 12th Intern. Conf. of Mine-Safety Res. Establ., Dortmund, W. Germany, 1967 /ts Paper No. 35
(SMRE-TRANS-5486) Available from Natl. Lending Library Boston Spa, Engl.

The explosion pressures and also the rates of pressure rise (dp/dt) of methane/air, hydrogen/air and acetylene/air mixtures were determined in three flameproof enclosures of the same shape but different volume. In the tests, the explosive mixtures were ignited by two known methods, which are used for testing resistance to ignition by projected particles, namely (1) by a three-phase arc and (2) by an exploding wire. In addition, the resistance to ignition by particles of five different shapes of gap was examined in hydrogen air and acetylene/air mixtures. From the results of the tests it was concluded that whilst the explosion pressures of the explosive mixtures ignited by high-energy arcs do not reach the level prescribed as the minimum test pressures for flame ignition-transmission resistance tests, it nevertheless appears sufficient, if the safety factor with regard to pressure safety is stipulated as 1.5 times the explosion pressure occurring the case of ignition by a low-energy ignition source and not as 1.5 times the explosion pressure occurring in the case of ignition by high-energy arcs. Author

N68-32592 National Lending Library for Science and Technology, Boston Spa (England).
MEASUREMENT OF EMISSION VARIATIONS IN TURBULENT DIFFUSION FLAMES [MESSUNG VON EMISSIONSSCHWANKUNGEN IN TURBULENTEN DIFFUSIONSFLAMMEN]
H.-D. Simon 20 Jun. 1968 18 p refs Transl. into ENGLISH from Chem.-Ing.-Tech. (Weinheim/Bergstrasse), v. 40, no. 3, Feb. 1968 p 121–128
(SMRE-TRANS-5811) Available from Natl. Lending Library, Boston Spa, Engl.

A photo-optical method was developed to measure local turbulence parameters in diffusion flames by means of flame emission, and two free jet gas streams were studied. Parameters measured were turbulence intensity, spectral functions, vortex dimensions, and linear dimensions of dissipation. The measurement recording was made by a photoelectric receiving device that distinguished local variations in emission in a narrow spectral zone. These variations are considered characteristic of the turbulent state of the flame field. The asymmetry of the recorded results indicated anisotropic turbulence in the flame field; and showed how turbulence was incited by the combustion process. M.W.R.

N68-32615# Air Force Systems Command, Wright-Patterson AFB, Ohio. Air Force Flight Dynamics Lab.
INFLUENCE OF FREE-STREAM TURBULENCE ON HYPERSONIC STAGNATION ZONE HEATING
Thomas M. Weeks May 1968 43 p refs
(AFFDL-TR-67-195; AD-671519)

The much ignored problem of turbulence in hypersonic ground test facilities is discussed with particular emphasis on arc-heated facilities. Sources of free-stream turbulence and their effects on model aerodynamics are identified. An analytical treatment of stagnation zone heating accounting for free-stream vorticity amplification and viscous dissipation is presented. Results are discussed in relation to three experiments: one involving time resolved measurements in an arc-heated wind tunnel, another involves stagnation point heat transfer measurements in the turbulent boundary layer of a hypersonic shock tunnel, and the third deals with similar measurements in a turbulent subsonic nitrogen plasma jet. In both of the latter experiments, stagnation point heating rates exceeding two to three times the calculated laminar expectation are reported. These results are corroborated by the present analysis. Author (TAB)

N68-32682 National Lending Library for Science and Technology, Boston Spa (England).
MEASURING THE MINIMUM ENERGY OF IGNITION OF EXPLOSIVE GAS, VAPOUR AND AIR MIXTURES [IZMERENIE MINIMAL'NOI ENERGII VOSPLAMENENIYA VZRYVCHATYKH GAZO-PAROVOZDUSHNYKH SMESEI]
V. S. Kravchenko, V. S. Komarov, and T. V. Belikova May 1968 8 p Transl. into ENGLISH from Bezopasnost Truda Prom. (Moscow), v. 8, no. 7 p 43–45
(RTS-4519) Available from Natl. Lending Library, Boston Spa, Engl.: 7s 6d

The equipment to determine the minimum energy of ignition and initial results with methane–air and hydrogen–air mixtures are briefly described. The test chamber is a cylinder having detachable, coaxial steel electrodes with adjustable spacing. A diagram is given of the electrical circuit which produces a capacitative, high voltage spark. Data on the dependence of ignition energy upon gap size show that the minimum energy for the methane mixture is 0.28 m joule for gaps greater than 2 mm. The critical gap size for the hydrogen mixture is 0.55 mm and the minimum energy is 0.014–0.015 m joule. N.E.N.

N68-32763 Northwestern Univ., Evanston, Ill.
SIMULTANEOUS MASS AND HEAT TRANSFER IN FLUIDIZED BEDS
Louis John Petrovic (Ph.D. Thesis) 1967 151 p
Available from Univ. Microfilms: HC $7.20/MF $3.00 Order No. 67-15314

This investigation deals with experimental work in two areas. Part A is concerned with the mass transfer in the flow of gases through packed beds for the low Reynolds number region. Part B involves the heat and mass transfer occurring in packed and fluidized beds of large particles. Dissert. Abstr.

N68-32784# Institute of Modern Languages, Inc., Washington, D. C. Translation and Interpretation Div.
DETERMINATION OF THE COEFFICIENTS OF HEAT TRANSFER ACCORDING TO THE DISTRIBUTION OF TEMPERATURES ON THE SURFACE OF HEAT-RELEASING PLATE [OPREDELENIE KOEFITSIENTOV TEPLO-OTDACHI PO RASPREDELENIYU TEMPERATUR NA POVERKHNOSTYAKH PLASTINY]
V. K. Shchukin Ft. Belvoir, Va. Army Engr. Res. and Develop. Labs. May 1968 13 p refs Transl. into ENGLISH from Tr. Kazansk. Aviats. Inst. (Kazan), no. 88, 1965 p 21–28
(Contract DAAK02-68-C-0396)
(ERDL-T-1925-68; AD-671700)

The determination of the coefficient of heat transfer according to the distribution of temperature on the side surfaces participating in the heat exchange makes it possible to find local and average coefficients of the heat exchange during random distribution of temperature in the system. In the present article the possible methods of processing the test data according to the coefficients of heat exchange between the flat, heat-releasing wall and a liquid are discussed. Such a problem arises during the process of experimental investigation of heat exchange in the magnetic field during the flow of the liquid through a plane channel when Joule heat is released in the wall side. TAB

N68-32792# National Research Council of Canada, Ottawa (Ontario).
THE DETERMINATION OF THE HEAT CONTENT AND SPECIFIC HEAT OF FUSED LIME CRYSTALS BETWEEN 0 AND 1720°C [DIE BESTIMMUNG DES WAERMEINHALTS UND DER SPEZIFISCHEN WAERME VON SCHMELZKALK-KRISTALLEN ZWISCHEN 0 AND 1720°C]

W. A. Fischer and W. Ertmer 1967 17 p refs Transl. into ENGLISH from Arch. Eisenhuettenwesen, v. 37, no. 4, 1966 p 275–281
(NRC-TT-1303) CFSTI: HC $3.00/MF $0.65

Fused lime single crystals (crystalline calcium oxide) weighing between 13 and 45 g were used, and various calorimeter arrangements were developed for determining the heat content between 0° and 25°, 25° and 65°, 25° and 1400°, and 25° and 1720° C. Details are given on the four series of experiments which were conducted. From the experimental values, the heat content and mean specific heat are calculated for the reference temperatures 0° and 25° C, and the true specific heat is determined graphically from the mean specific heats referred to 0° C. The heat content curve is drawn and compared with a number of curves derived or calculated from the literature data on burnt lime. In some cases, values beyond the limits of estimated error are noted. M.G.J.

N68-32935# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ANALYTICAL DEPENDENCE OF LIQUID OXYGEN DENSITY ON TEMPERATURE AND PRESSURE [ANALITICHESKAYA ZAVISIMOST' PLOTNOSTI ZHIDKOGO KISLORODA OT TEMPERATURY I DAVLENIYA]
V. N. Novotel'nov and L. A. Akulov 30 Aug. 1967 6 p refs Transl. into ENGLISH from Inzh.-Fiz. Zh. (Moscow), v. 9, no. 6, 1965 p 802–803
(FTD-HT-67-180; AD-671584)

The article proposes an approximate relationship between the density rho, temperature T, and pressure p of liquid oxygen. Data from the literature were processed by the method of least squares. Author (TAB)

N68-32947 Georgia Univ., Anthens.
HARMONIC AND ANHARMONIC CALCULATIONS ON THE THERMODYNAMIC PROPERTIES OF NACL-TYPE CRYSTALS
Tai-Hyung Kwon (Ph.D. Thesis) 1967 94 p
Available from Univ. Microfilms: HC $4.80/MF $3.00 Order No. 67-16231

The normal modes for NaCl-type crystals are found on the basis of the three-dimensional Born and von Karman model, a two-body potential interaction in a modified nearest neighbor approximation, and the classical theory of lattice dynamics. Based on the normal modes thus found, the Helmholtz free energy, internal energy, specific heats, equation of state, isothermal and adiabatic compressibilities, and thermal expansion coefficient for crystalline NaCl are calculated in the harmonic approximation. The anharmonic contributions to the specific heat due to cubic and quartic terms in the potential expansion are also calculated by statistical perturbation theory. The results of numerical calculations are presented to show the explicity dependence of each thermodynamic quantity considered on temperature T and the number N. To the extent observable (up to four significant figures) the thermodynamic functions are seen to have converged at N = 3 in the harmonic approximation and at N = 4 in the anharmonic calculation. Dissert. Abstr.

N68-32972*# Pratt and Whitney Aircraft, East Hartford, Conn.
VAPOR-CHAMBER FIN STUDIES Quarterly Report, May 28–Aug. 28, 1968
L. Langston and H. R. Kunz Sep. 1968 73 p refs
(Contract NAS3-7622)
(NASA-CR-54882; PWA-2698; QR-1) CFSTI: HC $3.00/MF $0.65 CSCL 20M

This report describes the work completed on an experimental and theoretical program formulated for obtaining an understanding of the operation of vapor-chamber fins. A mechanistic model and a simplified analysis of fin operation are derived. This model indicates that experimental data is necessary on the permeability, capillary rise, and boiling in fin wicks before an understanding of fin operation can be obtained. Experiments are therefore defined to obtain these quantities. Permeability will be determined by measuring the pressure drop as a function of liquid flow rate through wick specimens. Capillary rise will be determined by measuring the maximum static height that a liquid will rise in a wick. Boiling tests will determine the maximum heat flux density that can be added to liquid-filled wicks before film-boiling occurs. Descriptions of the experimental apparatus to be used in each of these tests are presented. The manner in which the results from these tests will be used to define fin operating characteristics is indicated. Author

N68-32974*# Miami Univ., Coral Gables, Fla. Dept. of Mechanical Engineering.
THERMAL CONDUCTANCE OF TWO DIMENSIONAL ECCENTRIC CONSTRICTIONS Interim Report
T. Nejat Veziroglu and Manuel A. Huerta Sep. 1968 28 p refs
(Grant NGR-10-007-010)
(NASA-CR-96281) CFSTI: HC $3.00/MF $0.65 CSCL 20M

A theoretical investigation of thermal conductance of two-dimensional eccentric constrictions has been carried out. By the use of conformal transformations, a closed form exact analytical solution has been obtained. The solution has been presented in terms of three dimensionless numbers—a conductance number, a constriction number and an eccentricity number. The theory has been checked with previously reported experimental results. The agreement is excellent. It has also been compared with two analytical expressions reported earlier. Author

N68-32988*# National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.
COMPARISON OF EXPERIMENTAL AND PREDICTED HEAT TRANSFER CHARACTERISTICS FOR A CYLINDRICAL EJECTOR
Francis C. Chenoweth and Fred W. Steffen Washington Aug. 1968 25 p refs
(NASA-TM-X-1641) CFSTI: HC $3.00/MF $0.65 CSCL 20M

The heat transfer characteristics of a cylindrical ejector for a small afterburning turbojet engine operating at static sea level conditions were compared with film-cooling correlations based on an insulated wall. Since the ejector in this tests was not insulated, a correction for radiation and free-convection losses was derived and applied to the wall temperatures calculated using one of the correlations. Good agreement was obtained between the experimental and predicted wall temperatures. Author

N68-32989*# Pratt and Whitney Aircraft, East Hartford, Conn.
VAPOR-CHAMBER FIN STUDIES Quarterly Report, Sep. 1–Nov. 30, 1968
L. S. Langston and A. Sherman Jan. 1968 52 p refs
(Contract NAS3-7622)
(NASA-CR-54922; PWA-2773; QR-2) CFSTI: HC $3.00/MF $0.65 CSCL 20M

This report describes the work completed during the second quarter of an experimental and theoretical program formulated for obtaining an understanding of vapor-chamber fins. During this period, wicking and boiling studies of porous materials applicable to fins were continued. Twenty-three porous metal samples were selected for study and ordered from suppliers. Ten of these have been received and are now being tested in the wicking rise apparatus. In these tests, the liquid front in each sample is being observed by use of litmus paper strips spaced along the sample. The data obtained has shown that a relatively long time, in the order of days, is required for a liquid front in a sample to reach

an equilibrium height. The apparatus for the wick boiling study was built and tested. Preliminary tests were run using a flat-plate sample. As yet no porous samples have been tested. A method of cutting these porous metal samples without disrupting the metal matrix has been devised. Author

N68-33016*# Boeing Co., Seattle, Wash. Space Div.
TRANSPIRATION COOLING SYSTEM DEVELOPMENT FOR REENTRY VEHICLES
C. L. Jaeck, R. T. Torgerson, and V. Deriugin Jul. 1968 144 p refs
(Contract NAS2-3443)
(NASA-CR-73246; D2-114181-1) CFSTI: HC $3.00/MF $0.65 CSCL 13A

The design, fabrication, and test of a transpiration system test panel module for reentry vehicles are described. The transpiration system was designed with the objectives of light weight, reusability, minimum refurbishment cost, and mission flexibility. The module development program consisted of four phases: materials evaluation, component analysis and development, fabrication of hardware, and test of the module in a plasma facility. This study demonstrated the feasibility of a transpiration system for reentry vehicles. Author

N68-33139 Louisiana State Univ., Baton Rouge.
HEAT TRANSFER BY DIRECT CONTACT OF IMMISCIBLE LIQUIDS IN A SPRAY COLUMN
James William McCaskill (Ph.D. Thesis) 1967 213 p
Available from Univ. Microfilms: HC $9.70/MF $3.00 Order No. 67-14000

Heat transfer between two immiscible liquids in a spray column was investigated. The liquids were Humbletherm 500 heat transfer oil and water, with the oil being the dispersed phase. The direction of heat transfer was from the oil to the water. The research was conducted in a specially constructed column which had a rectangular cross-section of 4 1/16 inches by 3 3/8 inches. Column length was 74 inches total and 48 inches for the constant cross-section central portion of the column. The front and back faces of the column were made of Pyrex glass plates to make it possible to obtain undistorted photographs of the drops. The effect of drop diameter and phase flow rates upon the rate of heat transfer in the column was determined. The effect of drop diameter was evaluated by using three different drop sizes. A wide range of flow rates was used for each phase for each drop size. Dissert. Abstr.

N68-33167*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
ANALYTICAL INVESTIGATION OF THERMAL DEGRADATION OF HIGH-PERFORMANCE MULTILAYER INSULATION IN THE VICINITY OF A PENETRATION
William R. Johnson and Earl L. Sprague Washington Sep. 1968 60 p refs
(NASA-TN-D-4778) CFSTI: HC $3.00/MF $0.65 CSCL 20M

An analytical investigation was conducted to determine the thermal degradation of high-performance multilayer insulation on a liquid hydrogen tank in the vicinity of a penetration. Results were obtained with and without the use of a thermal buffer zone between the shields and the pentration, for various values of thermal contact resistance. Input variables to the program included radiation source temperature, penetration diameter, number of shields, shield emissivity, shield thermal conductivity, shield spacing, buffer zone dimensions, and buffer zone thermal conductivity. The results of the program are presented in graphical form, as well as in equations representing curve fits of the analytical data. Author

N68-33203*# Pratt and Whitney Aircraft, East Hartford, Conn.
VAPOR CHAMBER FIN STUDIES. OPERATING CHARACTERISTICS OF FIN MODELS
H. R. Kunz, S. S. Wyde, G. H. Nashick, and J. F. Barnes Washington NASA Aug. 1968 95 p refs
(Contract NAS3-7622)
(NASA-CR-1139; PWA-3154) CFSTI: HC $3.00/MF $0.65 CSCL 13A

This report presents the test results from experiments on two vapor-chamber fin (heat pipe) geometries and compares these results with a theory developed and presented in a prior report. Typical temperature distributions were obtained for heat pipe operation plus limiting heat flux data which was compared to the theory. This comparison indicated that the theory showed the correct trends at low levels of heat flux. An effect of working fluid inventory was found which was not included in the present theory. Tests with a noncondensable gas present in the chamber were found to result in complete mixing of this gas with the working fluid vapor. Author

N68-33208*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
SINGLE-THERMOCOUPLE METHOD FOR DETERMINING HEAT FLUX TO A THERMALLY THICK WALL
Floyd G. Howard Washington Sep. 1968 51 p refs
(NASA-TN-D-4737) CFSTI: HC $3.00/MF $0.65 CSCL 20M

A method that accounts for variable thermal properties has been developed for determining heat flux from a single temperature-time history within a thermally thick wall. The accuracy depends on the thermal depth of the measurement point, and ranges from good to excellent for a number of practical cases, with best results occurring nearest the heated surface in conjunction with a small computing interval. The method is believed to be as accurate, if not more so, than other methods utilizing multiple thermocouples. If measurement is near the heated surface and accurate, the method can detect sudden changes in slope of heat flux such as are experienced when boundary layer flow becomes transitional or when heating rate history fluctuates as a result of body motions in flight. Author

N68-33260# General Electric Co., Philadelphia, Pa. Missile and Space Div.
RADIATION HEAT FLUX FROM HIGH PRESSURE ARCS Final Report
C. H. Marston, G. Frind, and B. Damsky Arnold AF Sta., Tenn. Arnold Eng. Develop. Center Jul. 1968 114 p refs
(Contract F40600-67-C-0005)
(AEDC-TR-68-146; AD-671530)

An ablation type constrictor was developed in which an electric arc at very high pressure is sufficiently stable for spectrographic measurements. Radial temperature distributions were determined for 250 ampere arcs in Delrin, $(CO{H_2})_n$, plasma at 100 and 150 atmospheres. Voltage gradient is constant along the arc axis and as high as 500 volts/cm. Pressure gradient in the constrictor is negligible. These two results indicate strongly that in spite of the self-induced flow field, the ablation type arc is homogeneous along the column. Temperature measurement was based on non-optically thin Abel inversion of continuum intensity measurements useful to an optical depth of one or more, which related temperature to theoretically computed continuum emission. A previously developed arc radiation model was extended to include a few selected lines, and these contribute significantly to total radiation because they are very much broadened. Author (TAB)

N68-33264# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
CONVECTION HEAT EXCHANGE IN A CLOSED SPACE BETWEEN TWO ROTATING DISKS UNDER TURBULENT

CONDITIONS FLOW [KONVEKTIVNYY TEPLOOBMEN V ZAMKNUTOY POLOSTI MEZHDUE DVUMYA VRASHCHA-YUSHCHIMISYA DISKAMI PRI TURBULENTNOM REZHME TECHENIYA]

V. M. Kapinos *In its* News of Inst. of Higher Learning Aeron. Eng., No. 1, 1966 2 Oct. 1967 p 21–30 refs (See N68-33261 20-23)

In the construction of multistage wheels of gas turbines the temperature of convection heat transfer between disks, occurring in a field of considerable contrifugal force cannot be neglected. The article develops a system of equations for the calculation of this factor. Author

N68-33350# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

JOURNAL OF ENGINEERING PHYSICS, VOLUME 9, NO. 2, 1965 (SELECTED PARTICLES)

2 Nov. 1967 18 p refs Transl. into ENGLISH from Inzh.-Fiz. Zh., Akad. Nauk Belorussk. SSR (Minsk), v. 9, no. 2, 1965 p 180–186, 250–254

(FTD-HT-23-854-67; AD-669312)

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1. SYSTEM OF PLANE TURBULENT JETS I. S. Makarov and B. G. Khudenko p 1–8 refs (See N68-33351 20-12)

2. NONLINEAR STATIONARY SYSTEM OF DIFFERENTIAL EQUATIONS OF HEAT AND MASS TRANSFER M. S. Smirnov p 9–14 (See N68-33352 20-33)

N68-33352# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

NONLINEAR STATIONARY SYSTEM OF DIFFERENTIAL EQUATIONS OF HEAT AND MASS TRANSFER

M. S. Smirnov *In its* J. of Eng. Phys., Vol. 9, No. 2, 1965 2 Nov. 1967 p 9–14 (See N68-33350 20-33)

Heat and mass transfer in heat and mass transfer processes are determined by a system of nonlinear parabolic equations and corresponding initial and boundary conditions. The effect of sources and escape of heat and mass are considered. The equation system combines two parabolic equations connected by additional terms which contain time and coordinate derivatives. The solution to this equation system is particularly interesting in the stationary case when the process becomes independent of time and the partial time differentials may be excluded, as well as when the effect of the dependence of the heat and mass exchange characteristics on temperature and mass transfer potential is particularly apparent not at the initial stage but later, when the process approaches the stationary state. Nonlinear unidimensional stationary problems with boundary conditions of the first order are investigated. Author

N68-33440*# Atlantic Research Corp., Alexandria, Va. Kinetics and Combustion Group.

COMPOSITE SOLID PROPELLANT FLAME MICROSTRUCTURE DETERMINATION Annual Report, 23 Jun. 1967–22 Jun. 1968

Raymond Friedman, Martin Hertzberg, Edward T. McHale, and Guenther von Elbe 22 Jun. 1968 44 p refs

(Contract NAS1-7457)

(NASA-CR-66677) CFSTI: HC $3.00/MF $0.65 CSCL 21B

Studies are presented of (1) the development of an experimental capability to probe the structure of heterogeneous propellant flames and (2) the utilization of this capability for exploration of the various contiguous flame zones. The purpose is an improved understanding of propellant flame characteristics by acquisition of definitive data on the physical and chemical processes in the combustion zone. Probes were developed for low-pressure flames of pressed strands of ammonium perchlorate (AP) and combinations of AP strands with sheets of organic binders in sandwich configurations. The temperature is measured by fine thermocouples embedded in the sample. The gas flow is observed by the particle track method. The distribution of molecular species is determined by means of small stationary or moving sampling probes leading to a mass spectrometer. Author

N68-33462 Rice Univ., Houston, Tex.

CONDENSATION OF A PURE VAPOR, AND NATURAL CONVECTION ON A FINITE-SIZE HORIZONTAL PLATE

James Vinson Clifton, Jr. (Ph.D. Thesis) 1967 88 p

Available from Univ. Microfilms: HC $4.60/MF $3.00 Order No. 67-13062

The objective of this investigation was to study both theoretically and experimentally, the steady state, two-dimensional, flow of viscous, heat conducting fluids across a finite size horizontal plate. Three problems were examined theoretically; namely (1) the condensation of a pure saturated vapor on a horizontal plate, (2) the natural convection on a horizontal plate and (3) the condensation of water vapor from an air-vapor mixture on a horizontal plate. Also, the problem of the slow, constant flow of a liquid across a horizontal plate was examined both theoretically and experimentally. For the problem of condensation of a vapor, the equations which describe the creeping motion of a liquid condensate film flowing across a finite size horizontal plate and off the plate edge, including the effects of surface tension, hydrostatic pressure, and viscous forces, are derived. Dissert. Abstr.

N68-33512*# Michigan Univ., Ann Arbor. Gas Dynamics Labs.

DROP SIZE EFFECTS IN SPRAY DETONATIONS

E. K. Dabora, K. W. Ragland, and J. A. Nicholls [1968] 28 p refs Presented at the 12th Intern. Symp. on Combust., Poitiers, France, 14–20 Jul. 1968

(Contract NASr-54(07))

(NASA-CR-96366) CFSTI: $3.00 CSCL 21B

Experimental results on the development and propagation of detonation in sprays of liquid diethylcyclohexane (DECH) in gaseous oxygen are presented. Drop sizes of 290μ, 940μ, and 2600μ were used. It was found that the smaller the drop size, the faster the detonation developed into a steady state. The steady velocity for mixtures ranging from 0.2 to 1.0 in equivalence ratio was found to be lower than the ideal Chapman-Jouguet velocity. Heat transfer measurements and inferred frictional losses to the walls are used, in conjuction with a reaction length assumed to be controlled by the breakup of the drops, to derive a relationship between the experimental and the ideal velocities. The relationship shows direct dependence of velocity on drop size and results in a calculated difference of 4% 10%, and 26% for the 290μ, 940μ, and 2600μ sprays respectively. Schlieren and direct light photographs show a rather complicated structure of the flow field behind the front due to the interaction of the gaseous convective flow and the initially stationary drops. Author

N68-33514*# Louisiana State Univ., Baton Rouge. Div. of Engineering Research.

A METHOD TO PREDICT THE THERMAL CONDUCTANCE OF A BOLTED JOINT

John E. Fontenot, Jr. and Charles A. Whitehurst [1968] 37 p refs Sponsored in part by NSF

(Grant NGR-19-001-35)

(NASA-CR-96316) CFSTI: HC $3.00/MF $0.65 CSCL 20M

A practical analytical method was developed to predict the interface thermal conductance of a bolted joint from a minimum of design information. Simple equations were developed to describe the thermal conductance across the interfacial contact zone and the interfacial gap. Use was made of methods to determine the

interfacial contact pressures and the width of the interface gap. Calculated values of interface conductance were used in finite-difference heat transfer analyses, and the computed interface temperatures were compared with values measured in nine experiments. Author

N68-33516*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
STATISTICAL MECHANICAL THEORIES OF TRANSPORT PROPERTIES
Richard S. Brokaw Washington 1968 64 p refs Presented at the Intern. Conf. on the Properties of Steam, Tokyo, 9–13 Sep. 1968
(NASA-TM-X-52478) CFSTI: HC $3.00/MF $0.65 CSCL 20M

Transport theories are considered in relation to the properties of the: (1) dilute gas, (2) dissociating gas, (3) moderately dense gas, (4) gas in the critical region, and (5) liquid state. These statistical mechanical theories of transport properties can be of aid in correlating and selecting properties of steam under many conditions where experimental data are available and can make reasonable predictions in some regimes where there are no data. Theory of monatomic gases is discussed along with modifications available to treat polyatomic gases. The theory for the dilute monatomic gas is well developed and applies well to the noble gases, and heat conductivities of these gases can be predicted from their viscosities. Since there are no data on properties of steam at temperatures above 2000° C, theory must be used in such cases. Heat conductivity tends toward infinity as the critical point is approached; and quantitative predictions can be made by an adjustment to a theory based on the diffusion and dissociation of large clusters. It is noted that the theory of the liquid state has not advanced sufficiently to be useful in predicting or correlating the properties of water. M.W.R.

N68-33551# Massachusetts Inst. of Tech., Cambridge. Engineering Projects Lab.
THE DETERIORATION IN HEAT TRANSFER TO FLUIDS AT SUPERCRITICAL PRESSURE AND HIGH HEAT FLUXES
Bharat S. Shiralkar and Peter Griffith 30 Jun. 1968 186 p refs Sponsored by Am. Elec. Power Serv. Corp.
(DSR-70332-55)

At slightly supercritical pressure and in the neighborhood of the pseudo-critical temperature, the heat transfer coefficient between fluid and tube wall is strongly dependent on the heat flux. For large heat fluxes, a marked deterioration takes place in the heat transfer coefficient in the region where the bulk fluid temperature is below and the wall temperature above the pseudo-critical temperature. An analysis was developed, based on the integration of the transport equations, to predict the deterioration in heat transfer at high heat fluxes, and the results have been compared with the previously available experimental results for steam. Experiments have been performed with carbon dioxide for additional comparison. Limits of safe operation in terms of the allowable heat flux for a particular flow rate have been determined both theoretically and experimentally. Experiments with twisted tape inserted in the test section to generate swirl have shown that the heat transfer rates can be improved by this method. Author

N68-33559 Washington Univ., Seattle.
THE NATURAL CONVECTION OF FLUIDS IN RECTANGULAR VERTICAL ENCLOSURES
Robert Keith MacGregor (Ph.D. Thesis) 1967 274 p
Available from Univ. Microfilms: HC $12.40/MF $3.55 Order No. 67-14189

The net heat transfer and local effects for free convection flows within a rectangular vertical enclosure were ivestigated experimentally and analytically for cases of both constant temperature and constant flux heating. Experimental measurements of local temperatures and net heat flux were obtained and correlations are presented for the net heat transfer in both laminar and turbulent boundary layer regimes. Numerical solutions were obtained for constant and variable property cases and are compared with the experimental data and correlations. Dissert. Abstr.

N68-33560 Rice Univ., Houston, Tex.
FREEZING OF FLUIDS IN FORCED FLOW
Richard Troy Beaubouef (Ph.D. Thesis) 1967 48 p
Available from Univ. Microfilms: HC $3.00/MF $3.00 Order No. 67-13052

The problem of freezing of a fluid in steady plane flow over a cold surface has been solved by numerical integration. Basic assumptions were: a) one-dimensional heat conduction in the solid phase; b) knowledge of the convective heat flux, q_c, as a function of the stream-wise coordinate, x. Thickness of the deposited solid phase was determined in non-dimensional form as a function of a non-dimensional time variable for three values of the single physical parameter, $\gamma(\gamma = 0.01, 1.0$ and $10.0)$. These results were employed to yield the dimensional thickness of the deposited solid phase as a function of time and location on the cold surface for water in plane stagnation flow and in flow over a flat plate at zero incidence. In addition, an approximate solution for the thickness of the deposited solid phase was obtained, which proved to be reasonable for $\gamma < 1$. Dissert. Abstr.

N68-33576# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
HEAT TRANSFER IN TURBOJET COMBUSTION CHAMBERS AND EXPERIMENTATION ON FILM COOLING EFFECTS
Chung-tse Tu, K'o-tao Yin, and Neng-k'un Chen *In its* J. of Mech. Eng. 14 Jul. 1968 p 1–31 refs Presented at the 1st All-China Ann. Appl. Thermophys. Symp., Aug. 1965 (See N68-33575 20-28)

The authors describe and discuss the experimental results on measurement of turbojet flame tube wall temperatures obtained on a single duct combustion chamber test equipment. The principal contents include: (1) description of the test equipment and measuring methods; (2) effort of air inlet parameters (total pressure, total temperature, and airflow) of the combustion chamber and that of residual gas coefficient on axial distribution of flame tube wall temperatures; and (3) comparison of wall temperature distributions along a flame tube, with and without film cooling, under similar operating conditions. The authors also propose a method for calculating the film cooled wall temperatures and heat transfer processes of a flame tube, and present their views on wall temperature calculation results compared with experimental data. Author

34 GENERAL

Includes reports of a broad nature related to industrial applications and technology, and to basic research; defense aspects; law and related legal matters; and legislative hearings and documents.

N68-32382# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
SPACE WEAPONS
K. V. Morozov 1 Sep. 1967 50 p Transl. into ENGLISH from Kosmicheskoe Oruzhie (Moscow), 1966 p 1–54
(FTD-MT-24-121-67; AD-671432)

This pamphlet states that the goal of the United States space program is military supremacy in space while Soviet efforts are for peaceful scientific explorations in the service of the national economy. The pamphlet claims that the Soviet Union has maintained a constant lead over the United States in space and that much of what has been done by the United States has been a process of copying the Soviet Union. Author (TAB)

N68-32632# National Research Council of Canada, Ottawa (Ontario).
EXPERIENCE IN THE IMPLEMENTATION OF CROP PROTECTION BY AIRCRAFT IN AGRICULTURE [ERFAHRUNGEN AUS DEM EINSATZ EINES PFLANZENSCHUTZFLUGZEUGES IM AKERBAU]
Friedrich Baltin 1968 9 p Presented at the 4th Intern. Congr. of Crop Protect., Hamburg, 8–15 Sep. 1957
(NRC-TT-1331) CFSTI: HC $3.00/MF $0.65

The feasibility of aerial pest control is discussed with respect to the cost factor based on time. The relations between total time, mean field area, and pesticide consumption per hectare are considered, along with the effect of base-to-field distance on total time for various consumption rates. Experiments are described, and economic and biological evaluations are discussed. N.E.N.

N68-32710# Congress. House. Committee on Sciences and Astronautics.
UTILIZATION OF FEDERAL LABORATORIES
GPO 1968 461 p Hearing before the Subcomm. on Science, Res., and Development, 90th Congr., 2d Session, 26–28 Mar.–2–4 Apr. 1968

The record of these hearings covers the detailed testimony of representatives of several federal offices and departments engaged in scientific and technical research and development. Included is also the testimony of three representatives of non-government institutions which either make use of government facilities or are engaged in contract work for the federal government. K.W.

N68-32721# Technische Univ., Berlin (West Germany). Institut fuer Raumfahrttechnik.
A MACRO MODEL FOR THE EVALUATION OF THE "ORDER OF MAGNITUDE" OF BENEFITS FROM SPACE RESEARCH FOR THE GERMAN FEDERAL REPUBLIC [EIN MAKRO-MODELL FUER DIE ABSCHAETZUNG DER GROESSENORDNUNG DES AUS DER WELTRAUMFORSCHUNG ABLEITBAREN NUTZENS FUER DIE BRD]
31 May 1968 68 p refs In GERMAN; ENGLISH summary Supported in part by Bundesmin. fuer Wiss. Forsch.
(TUB-IR-1968/4) CFSTI: HC $3.00/MF $0.65

This report describes a macro-model for the determination of the "order-of-magnitude" of the observed and potential benefits which can be derived from space research activities for the German Federal Republic. This interim report concentrates on the description of a basic model to be used for further iterations as a base to deviate from. The DELPHI method will be used to improve on this model. Preliminary estimates indicate an economical benefit in the order of 2.5 billion dollars for the year 1985. The scientific and political benefits will have to be added to this and can easily double this figure. Additional studies are required before a reasonable picture can be obtained concerning the cost-effectiveness of space activities from the viewpoint of the German Federal Republic. Author

N68-32769*# National Aeronautics and Space Administration, Washington, D. C.
BIBLIOGRAPHIES ON AEROSPACE SCIENCE A Continuing Bibliography With Indexes
Jul. 1968 134 p refs
(NASA-SP-7006(03)) CFSTI: HC $3.00/MF $0.65 CSCL 05B

An annotated bibliography is presented which provides references to bibliographies, literature searches, abstract compilations, literature reviews and surveys, and report listings pertaining to aerospace subjects. Technical reports containing comprehensive reference listings are included along with a subject index. B.S.D.

N68-33201*# Washington Univ., St. Louis, Mo. Inst. for Urban and Regional Studies.
IMPACT OF FEDERAL PROCUREMENT ON PERSONAL INCOME DISTRIBUTION
Gerald W. Williams (Ph.D. Thesis) Jul. 1968 112 p refs Sponsored in part by the Econ. Develop. Admin.
(Grant NsG-342)
(NASA-CR-96469; EDA-11) CFSTI: HC $3.00/MF $0.65 CSCL 05C

The increase in Federal spending, both for defense and nondefense purposes, has heightened people's interest in the consequent economic impacts of these new expenditures. Most economists generally acknowledge that such changes in spending affect the economy chiefly by altering aggregate income. However an alteration in Federal expenditures may also change personal distribution of income. There has been little systematic analysis in studying this distributional impact, and the past studies possess numerous shortcomings. The present research directs itself toward filling this gap. Specifically its purpose is to measure the income redistribution that occurs given a change in the level or composition of expenditures of the Federal government. The analysis is further concentrated on the distributional impact of Federal purchases of goods and services, and the implications that follow from such a measurement. Author

N68-33247# Advisory Group for Aerospace Research and Development, Paris (France).
STORAGE AND RETRIEVAL OF INFORMATION: A USER-SUPPLIER DIALOGUE
Jun. 1968 65 p refs Presented at the TIP-AvP Symp., Munich, 18–20 Jun. 1968
(AGARD-ES-2) CFSTI: HC $3.00/MF $0.65

Extended summaries are presented for 15 papers on information storage and retrieval given at an AGARD symposium in June 1968. Topics considered include communication and secrecy in science, the information suppliers point of view, and non-numerical mathematics and data processing. The organization of dictionaries and thesauruses is treated as are character and pattern recognition, transfer of textual information, and on-line storage and retrieval. Manual and mechanized systems are discussed; cost effectiveness of information systems is summarized; and the interrelationships among information, communications, systems, and applications are reviewed in relation to growing complexity of technological processes. Details are included for NASA's Selective Dissemination of Information (SDI) system. Interactive information processing, retrieval, and transfer is considered as are the man–machine interface and the education requirements for users and suppliers of scientific and technical information. M.W.R.

N68-33382# Congress. House. Committee on Science and Astronautics.
SYMPOSIUM ON UNIDENTIFIED FLYING OBJECTS
Washington GPO 1968 254 p refs Hearings before Comm. on Sci. and Astronautics, 90th Congr., 2d Sess., No. 7, 29 Jul. 1968

Hearings before the Committee on Science and Astronautics of the U.S. House of Representatives present a symposium on unidentified flying objects. Statements at the July 29, 1968, session were made by six scientists and prepared papers by six other

scientists. The statements were by university professors affiliated with astronomy, meteorology, sociology, and civil engineering departments as well as by an industrial scientist who also teaches at the university level. The prepared papers represent scientists affiliated with university activities at an observatory, in counseling and testing, psychological research, and plant science as well as two industrial scientists. M.W.R.

Collections of NASA Documents

N68-33590# Advisory Group for Aerospace Research and Development, Paris (France).
GENERAL INFORMATION
1968 29 p
(AGARD-GI-1968) CFSTI: HC $3.00/MF $0.65

An overview is presented on the operation and organization of AGARD. Staff members, national delegates, and the executive committee are listed, and a chart is included on the national membership of the panels and committees. Panel activities are highlighted. M.G.J.

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